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MINERALS YEARBOOK

Area Reports: International 2000

Africa and the Middle East

Volume III

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MINERALS YEARBOOK

Area Reports: International 2000

Africa and the Middle East

Volume III

U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY
CHARLES G. GROAT, Director

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Foreword

This edition of the U.S. Geological Survey (USGS) Minerals Yearbook discusses the performance of the worldwide minerals and materials industries during 2000 and provides background information to assist in interpreting that performance. Content of the individual Minerals Yearbook volumes follows:

- Volume I, Metals and Minerals, contains chapters about virtually all metallic and industrial mineral commodities important to the U.S. economy. Chapters on survey methods, summary statistics for domestic nonfuel minerals, and trends in mining and quarrying in the metals and industrial minerals industries in the United States are also included.
- Volume II, Area Reports: Domestic, contains a chapter on the mineral industry of each of the 50 States and Puerto Rico and the Administered Islands. This volume also has chapters on survey methods and summary statistics for domestic nonfuel minerals.
- Volume III, Area Reports: International, is published as four separate reports. These regional reports contain the latest available minerals data on more than 190 foreign countries and discuss the importance of minerals to the economies of these nations and the United States. Each report begins with an overview of the region's mineral industries during the year. It continues with individual country chapters that examine the mining, refining, processing, and use of minerals in each country of the region and how each country's mineral industry relates to U.S. industry. Most chapters include production tables and industry structure tables, information about Government policies and programs that affect the country's minerals industry, and an outlook section.

The USGS continually strives to improve the value of its publications to users. Constructive comments and suggestions by readers of the Minerals Yearbook are welcomed.

Charles G. Groat, Director

Contacts

Information about the U.S. Geological Survey, its programs, staff, and products may be accessed on the World Wide Web at URL http://www.usgs.gov/ or by contacting the Earth Science Information Center at 1-888-ASK-MAPS. For specific information about this publication, contact the Chief, International Minerals Section, Minerals Information Team, at (703) 648-7732 or the Chief, Publication Services Section, Minerals Information Team, at (703) 648-7790. Additional minerals information may be accessed on the World Wide Web at http://minerals.usgs.gov/minerals/.

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The Country Specialists in the Minerals Information Team, U.S. Geological Survey, in preparing the International Review regional books of Volume III of the Minerals Yearbook, extensively use statistics and data on mineral production, consumption, and trade provided by various foreign Government minerals and statistical agencies through various official publications. The cooperation and assistance of these organizations are gratefully acknowledged. Statistical and informational material was also obtained from reports of the U.S. Department of State, United Nations publications, and the domestic and foreign technical and trade press. Of particular assistance were reports submitted by the Resource Reporting Officers and other officers of the Department of State in U.S. Embassies worldwide. Their contributions are sincerely appreciated. Internal statistical support was provided by the staff of the Data Collection and Coordination Section of the Minerals Information Team.

The regimes of some countries reviewed in this volume may not be recognized by the U.S. Government. The information contained herein is technical and statistical in nature and is not to be construed as conflicting with or being contradictory of U.S. foreign policy.

John H. DeYoung, Jr.
Chief Scientist, Minerals Information Team

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THE MINERAL INDUSTRIES OF

AFRICA

By George J. Coakley, Philip M. Mobbs, Philip A. Szczesniak, David R. Wilburn, and Thomas R. Yager

The 55 independent nations and other territories of continental Africa and adjacent islands that are covered in this volume encompass a land area of 30.3 million square kilometers, which is more than three times the size of the United States, and were home to 788.5 million people in 2000. For many of these countries, mineral exploration and production constitute significant parts of their economies and remain keys to future economic growth. Africa is richly endowed with mineral reserves and ranks first or second in terms of amount of world reserves of bauxite, chromite, cobalt, diamond, gold, manganese, phosphate rock, platinum-group metals (PGM), titanium minerals (rutile and ilmenite), vanadium, vermiculite, and zirconium.

General Economic Conditions

In 2000, according to the International Monetary Fund (2001, p. 195), the gross domestic product (GDP) of Africa grew by 2.8% after growing by 2.5% in 1999. From 1995 to 2000, African GDP growth averaged 3.4% per year. During the same period, population growth averaged 2.4% per year. The increase in petroleum prices for non-oil-producing countries and the decrease in many nonfuel commodities prices had an adverse effect upon the economies of numerous African countries; Ghana, Zambia, Mali, Madagascar, Chad, and Ethiopia were the most heavily affected countries in 2000.

In 2001, according to projections by the International Monetary Fund (2001, p. 2, 44, 262), the region's real GDP was expected to increase by 3.8%; in 2002, by 4.4%; and in 2003 to 2006, by an average of 5.1% per year. The projected improvement in GDP growth was based on factors that included better weather conditions (which would aid agricultural output) and the reduction of civil conflict in several regions. In Algeria, growth was expected to be 3.8% in 2001 and 4.9% in 2002. Côte d'Ivoire was projected to have -1% GDP growth in 2001 and 3.5% in 2002. Nigeria's economic growth was expected to be 3.1% in 2001 and 2.2% in 2002. Tanzania was projected to have 5.9% growth in 2001 and 6.2% in 2002.

Investment Interest and Political Risk

A review of company investment plans for the period 2000 to 2007 indicated the potential for the region to attract more than $44 billion in oil and gas developments, primarily in Angola and Nigeria. More than $26 billion in mining and mineral processing projects, which included nonferrous metals investments of $9.55 billion; ferrous metals, $4.82 billion; gold, $4.55 billion; and PGM, $3.7 billion, were planned (table 17). The mining and mineral processing projects were chiefly in South Africa, Mozambique, and Zambia. Most of the identified projects were at least at the engineering feasibility stage, but some were still awaiting favorable commodity market conditions or the arrangement of project financing. South African investment abroad continued to accelerate, with some of the smaller South African companies, such as Durban Roodeport Deep Ltd., making their debut on the international scene by investing in gold mining in Australia.

During 2000, the Government of Zambia completed the privatization of its copper industry that began in the mid-1990s. Other privatization of state-owned industries included cement plants in Sudan and Tunisia and electricity companies in Rwanda and Togo.

Civil wars, internal ethnic or political conflicts, and refugee displacements continued to destabilize a number of African countries and constrained new investment in mineral exploration and development in many areas. Countries directly affected in 2000 included Algeria, Angola, Cameroon, Congo (Brazzaville), Congo (Kinshasa), Eritrea, Ethiopia, Guinea, Guinea-Bissau, Liberia, Nigeria, Rwanda, Sierra Leone, Somalia, Sudan, and Uganda. Angola, Namibia, Rwanda, Uganda, and Zimbabwe were affected by the burden of providing military assistance in the civil war in Congo (Kinshasa). In the Côte d'Ivoire, despite the continuing civil unrest that began in December 1999, the Government announced intentions to privatize 26 state-owned companies. The end of the war between Ethiopia and Eritrea in June 2000 gave hope for increased stability and an improved investment climate in that region.

Legislation

Efforts to revise mining legislation were undertaken during 2000 by the Governments of Algeria, the Central African Republic, Congo (Kinshasa), Gabon, Madagascar, Mali, Mauritania, Namibia, South Africa, and Tanzania. The draft of a law to reform the Algerian mining code to "end discrimination between local and foreign investors" was approved (Mining Journal, 2000a). In the Central African Republic, the World Bank helped prepare new mining legislation as part of a $20 million loan package. World Bank and International Monetary Fund (IMF) officials hoped for the passage of legislation that bars the Government from directly involving itself in mining ventures and that authorizes the sale of oil and gas licenses by auction in accordance with the Treaty for Harmonization of African Business Laws (also known as the OHADA Treaty, which was signed in 1993). A new Mining Code designed to lighten the tax burden in mining investment was adopted by the Gabonese Parliament (Mining Journal, 2000b). In Madagascar, mining regulations were overhauled, and the Bureau du Cadastre Minier de Madagascar was established to serve as a one-stop service for exploration and mine permitting. The Government of Mali revised the country's Mining Code, modified taxation and mine permitting provisions, and set up a new regional mining office in the western part of the country, nearer to the main mining areas.

In Namibia, the Diamond Act No. 13 of 1999 became effective April 1, 2000. This legislation, which included provisions for exploration and mining of offshore diamonds, regulated security procedures used in the mining, prospecting, selling, and exporting of diamonds. The South African Code for Reporting of Mineral Resources and Mineral Reserves, which was an attempt to set rules and guidelines for the reporting of mineral reserves/resources, was finalized after 2½ years of deliberations. Development of a new mineral policy for South Africa, which was designed to free up unused mineral rights which would be made available to new foreign investors or new local black economic empowerment groups, was under full consideration.

Exploration

International mineral exploration companies continued to cut back on exploration budgets, some down to the minimum required to hold leases. According to data gathered by the U.S. Geological Survey (USGS) and the Metals Economics Group (2000) of Halifax, Nova Scotia, Canada, the decline in exploration activity in Africa continued. The Metals Economics Group reported that Africa accounted for the second largest decline in budgeted exploration expenditure and the largest decline in spending share to $293 million (12.6 %) in 2000 from $377 million (14.7% of world budget) in 1999 and by 66% from the peak exploration expenditure level of $662 million in 1997; this decline in exploration spending was in line with the worldwide trend. Reasons for the decline include weak commodity prices, delayed implementation of policy reforms, and increased political instability (Weeks, 2000). Renewed outbreaks of civil war seriously interrupted mineral exploration and development in Angola, Congo (Kinshasa), and Sierra Leone. These conflicts also adversely affected the economies of neighboring countries. Côte d'Ivoire and Zimbabwe experienced an increase in political tension, which resulted in a less attractive venue for foreign investment.

A survey of major American petroleum companies compiled by the U.S. Energy Information Administration reported that their oil and natural gas exploration expenditure in Africa for 1999 (the last year for which data is available) was $1.268 billion, which was a 16% increase compared with that of 1998. Total hydrocarbon exploration expenditure in Africa compiled for the period from 1994 through 1999 was more than $5.3 billion (Davis and others, 2001, p. 94). Actual exploration expenditure was higher, because the survey excluded a number of multinational companies active in Africa.

The petroleum exploration boom focused on offshore western Africa has been stimulated by increased oil company interest in deepwater hydrocarbon plays and acceptance of the associated risk, by new geophysical technologies, by the development of deepwater drilling techniques, and by the opening of deepwater blocks by African governments. A June 2000 assessment by industry analysts Douglas-Westwood Associates indicated that western Africa has close to 17 billion barrels of oil equivalent in deepwater prospects; this included TotalFinaElf S.A.'s Girassol Field in Angola and Shell Petroleum Development Company of Nigeria Ltd.'s Bonga prospect in Nigeria (Knight and Westwood, 2001). Proposed annual capital investments to develop these resources were planned to exceed $5 billion by 2004.

Additionally, the Mauritanian Ministry of Mines has appointed the South African Council for Geoscience to conduct a 5-year $16.5 million program to update and generate geological information. The Africa Development Fund approved a $32 million loan for infrastructure development in Mali.

Commodity Review

The following section includes a review of production, consumption, and discussions of potential developments for individual commodities. The continent accounted for a significant portion of total world output for a number of mineral commodities. Africa's severe poverty, however, limited its capacity as a domestic market for mineral commodities. The commodity outlook segments are based upon projected trends that would affect current (2001) producing facilities and planned new facility capacities that the operating companies, consortia, or governments have projected to come online within the indicated timeframes. Projects that have received approval from a company's board of directors would be typical of projects that could have a chance of being implemented within the indicated timeframes. As such, projects listed in the following outlook sections are presented as an indication of current (2001) industry plans and are not a USGS prediction of what will occur.

Metals

Bauxite, Alumina, and Aluminum.—Production.—In 2000, Africa's production of bauxite was estimated to have increased slightly to 15.5 million metric tons (Mt), which represented about 11% of world production. Guinea remained the largest producer in Africa and the second largest bauxite-producing country in the world with output of about 15 Mt (Plunkert, 2002). Guinea was the only producer of alumina in Africa; its production was estimated to have increased by 10% in 2000. The country's estimated output of 550,000 metric tons (t) amounted to about 1% of global alumina production.

Africa's production of aluminum increased 6.7% to 1.17 Mt. This represents 5% of world production. Much of the increase was attributed to the partial return to traditional levels of production in Ghana. South Africa, which produced 58% of Africa's aluminum, remained the largest producer. The major development in this sector in Africa for 2000 was the commissioning of Billiton plc's $1.3 billion Mozal aluminum smelter near Maputo, Mozambique. Mozal, which had the capacity to produce 253,000 metric tons per year (t/yr) of aluminum, produced about 54,000 t of aluminum from July to December 2000.

Consumption.—Africa's share of the world's aluminum consumption in 2000 was 1%. Continental consumption reportedly rose to 327,900 t of aluminum in 2000 from 264,200 t in 1999. South Africa accounted for 57% and Egypt accounted for 25% of African aluminum consumption (World Bureau of Metal Statistics, 2001, p. 9).

TABLE 1
AFRICA: HISTORIC AND PROJECTED ALUMINUM PRODUCTION, 1990-2005 1/

(Thousand metric tons)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Cameroon	93	79	92	95	90	90	90
Egypt	179	180	193	200	200	200	200
Ghana	174	135	104	142	160	200	200
Kenya	--	2	2	2	2	2	2
Mozambique	--	--	--	54	250	500	500
Nigeria	--	--	16	--	--	--	190
South Africa	159	229	689	676	675	675	825
Total	605	625	1,100	1,200	1,400	1,700	2,000

-- Negligible or no production. e/ Estimated.

1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

Outlook.—Bauxite production is likely to show little change in 2001. Guinea's production of bauxite is expected to increase to 15.7 Mt in 2001 and to 16 Mt in 2003. Ghana, which produces abrasive-grade bauxite, is expected to increase its production to 700,000 t in 2001 and to 1 Mt in 2003.

In 2001, aluminum production is expected to increase by 20% to 1.4 Mt compared with production of 1.169 Mt in 2000. In 2005, aluminum production could reach 2 Mt. Table 1 lists projected aluminum production from African countries through 2005. The increased production is expected to come from the opening and proposed expansion of the Mozal smelter in Mozambique, the expansion of Hillside smelter in South Africa, full production from the Tema smelter in Ghana, and the reopening the Aluminium Smelter Co. of Nigeria Ltd. plant. The Mozal smelter in Mozambique is expected to lead an increase in African aluminum production; its output is expected to increase to about 250,000 t in 2001 from 53,800 t in 2000 (World Bureau of Metal Statistics, 2001, p. 6, 8-9). Billiton plc has announced plans to begin a feasibility study on doubling Mozal's capacity to 506,000 t/yr by 2003.

Chromite. The gross weight of Africa's production of chromite decreased by 1.6% to 7.478 Mt, which represented 52% of world production. South Africa produced 88.6% of Africa's chromite; its output declined to 6.621 Mt in 2000 from 6.817 Mt in 1999. Other African producers included Madagascar, Sudan, and Zimbabwe.

Copper and Cobalt.—*Production.*—In 2000, Africa's production of copper decreased by 6.4% to 465,000 t, which was about 4% of the world's total copper production, compared with 1969 when Africa had produced 1.38 Mt of copper, which then was about 24% of the total world copper production. Reduced production from the Congo (Kinshasa) and Zambia accounted for most of the significant declines in African copper production. The copper content of ore produced by Congo (Kinshasa) fell to 21,000 t in 2000 compared with 357,000 t of copper in ore in 1969. Zambia produced 241,000 t of copper in ore in 2000 compared with a copper content of 825,000 t in mine output in 1969.

In 2000, the privatization of Zambian Consolidated Copper Mines (ZCCM) was completed. The newly reorganized copper industry consists of two large private companies—Mopani Copper Mines Plc. (Mopani) and Konkola Copper Mines Plc. (Konkola)—and several smaller companies. Mopani purchased ZCCM's Mufulira Division and the Nkana Division's mining operation, concentrator, and cobalt plant. Konkola acquired the Konkola and the Nchanga Divisions of ZCCM, the Konkola deep mining project, the Chingola refractory copper ore stockpiles, the Nampundwe pyrite mine, the Konkola concentrator, the Nampundwe concentrator, and the Nchanga concentrator. The reorganized copper industry has committed $720 million toward the rehabilitation of mines and plants, subject to completion of favorable feasibility studies, and has proposed to invest an additional $1.1 billion for new mine developments by 2008. Production declined by more than 7% to 241,000 t in 2000 while rehabilitation work was underway.

In Congo (Kinshasa), the ongoing civil war continued to suspend most work on the rehabilitation of the La Générale des Carrières et de Mines (Gecamines) copper-cobalt production facilities or the development of new producing capacity. Offsite project engineering and feasibility studies were continuing. In Namibia, the Haib low-grade copper project was put on hold, and the smelter and mines of the former Tsumeb Copper Ltd. (TCL) reopened under new ownership.

In South Africa, Palabora Mining Company Ltd. began to

TABLE 2
AFRICA: HISTORIC AND PROJECTED COPPER MINE PRODUCTION, 1990-2005 1/

(Thousand metric tons)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Botswana	25	25	38	38	20	20	20
Congo (Kinshasa)	509	29	32	21	20	70	90
Morocco	16	14	8	7	(2/)	(2/)	(2/)
Namibia	28	23	--	19	25	30	40
South Africa	179	166	144	137	85	85	95
Zambia	519	316	270	241	300	450	450
Zimbabwe	14	9	5	2	(2/)	(2/)	(2/)
Undistributed	--	--	--	--	10	10	10
Total	1,290	582	497	465	460	670	710

-- Negligible or no production. e/ Estimated.

1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

2/ Included in "Undistributed."

transition from an 80,000-metric-ton-per-day (t/d) open pit mine to a 30,000-t/d underground mine.

Africa's production of cobalt more than doubled to 14,341 t in 2000 from 7,100 t in 1999. This represented 43% of the world total. Congo (Kinshasa) produced 7,000 t, or nearly 50% of Africa's cobalt; this was 600% more than Congo's (Kinshasa) production in 1999. Zambia was the second leading cobalt producer in Africa in 2000 with 4,600 t, or 32% of Africa's cobalt.

Consumption.—African consumption of copper rose to 125,500 t in 2000 compared with 110,200 t in 1999. In 2000, Africa's share of the world's copper consumption was less than 1%. South Africa, which was the dominant consumer of base metals in Africa, accounted for 61% of African copper consumption; Egypt, for 15% (World Bureau of Metal Statistics, 2001, p. 41).

Outlook.—Mine production is projected to increase through 2005, with rising output from Congo (Kinshasa), Namibia, South Africa, and Zambia more than offsetting falling output from Morocco (World Bureau of Metal Statistics, 2001, p. 37). In 2001, Zambia's copper mine production is expected to be 300,000 t; and in 2003, it is expected to reach 450,000 t. Refined copper output also is expected to increase.

Gold.—Production.—In 2000, Africa produced 604,543 kilograms (kg) of gold, or 24% of the world total; this represented a more than 4.5% decline from 1999. South Africa produced 430,778 kg, or 72% of Africa's gold; this was 4.5% less than South Africa's production in 1999.

Ghana was Africa's second largest producer; it produced 72,080 kg in 2000, which was a decline from its 1999 production of 79,946 kg. Gold production also declined in Zimbabwe. In 2000, gold production increased in Burkina Faso, Côte d'Ivoire, Ethiopia, Mali, Namibia, and Tanzania.

Outlook.—In 2001, the continuing three-decade-long decline in South African gold production will be at least partially offset by output from new mines in Mali and Tanzania. By 2007, gold production in South Africa is expected to decline to 420 t. Production in Ghana, Tanzania, Mali, and Guinea is projected to reach 62 t, 53 t, 50 t, and 19 t, respectively.

Numerous gold mines started up or were under construction in 2000. In Tanzania, the Bulyanhulu, the Geita, and the North Mara mines were expected to increase production by 34 t/yr by 2004; the Morila and the Yatela Mines in Mali, by more than 14 t/yr; the Samiri Hill Mine in Niger, by 4.7 t/yr; the Jean-Gobele Mine in Guinea, by 1.9 t/yr; and the Tirek Mine in Algeria, by 1.2 t/yr. In South Africa, development work continued on AngloGold Ltd.'s Moab Khotsong and Western Deep Levels Mines; the South Deeps Mine (a joint venture between Western Areas Gold Mining Co. Ltd. and Placer Dome Inc. of Canada); and the Target Mine of Avgold Ltd. These four mines represent capital investments of $2 billion and will add more than 53 t of gold to South Africa's gold mine capacity by 2003.

TABLE 3
AFRICA: HISTORIC AND PROJECTED GOLD MINE PRODUCTION, 1990-2007 1/

(Kilograms)

Country	1990	1995	2000	2007 e/
Benin	--	300	500	(2/)
Botswana	46	86	4	(2/)
Burkina Faso	7,800	1,319	1,000	(2/)
Burundi	9	2,000	1,500	(2/)
Cameroon	10	800	1,000	(2/)
Central African Republic	241	97	100	(2/)
Chad	--	--	120	(2/)
Congo (Brazzaville)	7	10	10	(2/)
Congo (Kinshasa)	9,300	1,180	52	(2/)
Cote d'Ivoire	20	1,983	3,154	(2/)
Eritrea	--	59	500	(2/)
Ethiopia	848	4,500	5,177	(2/)
Gabon	80	70	70	(2/)
Ghana	16,800	53,087	72,080	62,000
Guinea	6,340	7,863	13,300	19,000
Kenya	25	170	990	(2/)
Liberia	600	800	1,000	(2/)
Madagascar	216	38	9	(2/)
Mali	5,200	3,996	25,000	50,000
Mauritania	--	1,196	--	(2/)
Morocco	500	580	334	(2/)
Mozambique	63	6,800	23	(2/)
Namibia	1,610	2,394	2,456	(2/)
Niger	--	1,000	1,000	(2/)
Nigeria	--	5	10	(2/)
Rwanda	2,160	26	10	(2/)
Senegal	--	--	550	(2/)
Sierra Leone	32	4	30	(2/)
South Africa	605,000	523,809	430,778	420,000
Sudan	100	3,700	6,000	(2/)
Tanzania	3,500	320	15,060	53,000
Uganda	--	1,506	56	(2/)
Zambia	129	91	600	(2/)
Zimbabwe	16,900	23,959	22,070	(2/)
Undistributed	--	--	--	40,000
Total	678,000	644,000	605,000	600,000

-- Negligible or no production. e/ Estimated.

1/ Estimated data and totals are rounded to no more that three significant digits; may not add to totals shown.

2/ Included in "Undistributed."

TABLE 4
AFRICA: HISTORIC AND PROJECTED IRON ORE MINE PRODUCTION, 1990-2005 1/

(Thousand metric tons)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Algeria	2,940	2,200	1,336	1,645	(2/)	(2/)	(2/)
Egypt	2,410	2,043	3,000	2,500	(2/)	(2/)	(2/)
Mauritania	11,600	11,610	10,401	10,400	10,400	10,000	10,000
Morocco	148	47	7	6	(2/)	(2/)	(2/)
Nigeria	374	168	--	--	(2/)	(2/)	(2/)
South Africa	30,300	31,946	29,512	33,707	35,000	38,000	38,000
Tanzania	--	43	--	--	(2/)	(2/)	(2/)
Tunisia	291	224	219	182	(2/)	(2/)	(2/)
Uganda	--	--	3	5	(2/)	(2/)	(2/)
Zimbabwe	1,260	311	599	451	(2/)	(2/)	(2/)
Undistributed	--	--	--	--	4,500	4,500	4,500
Total	49,000	49,000	45,000	49,000	50,000	53,000	53,000

-- Negligible or no production. e/ Estimated.
1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.
2/ Included in "Undistributed."

TABLE 5
AFRICA: HISTORIC AND PROJECTED STEEL PRODUCTION, 1990-2005 1/

(Thousand metric tons)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Algeria	836	827	758	842	700	800	900
Benin	8	--	--	--	(2/)	(2/)	(2/)
Egypt	2,240	2,642	2,619	2,820	3,800	3,800	4,000
Ghana	26	25	75	75	(2/)	(2/)	(2/)
Kenya	20	20	25	25	(2/)	(2/)	(2/)
Libya	492	909	945	1,055	900	1,200	1,300
Morocco	7	7	5	5	(2/)	(2/)	(2/)
Nigeria	220	36	--	--	(2/)	(2/)	(2/)
South Africa	8,620	8,741	6,830	7,019	9,000	9,000	9,000
Tunisia	177	201	229	237	240	240	250
Uganda	--	12	15	7	(2/)	(2/)	(2/)
Zimbabwe	580	210	255	269	(2/)	(2/)	(2/)
Undistributed	--	--	--	--	300	350	350
Total	13,200	13,600	11,800	12,400	14,900	15,400	15,800

--Negligible or no production. e/ Estimated.
1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.
2/ Included in "Undistributed."

Iron and Steel.—Production.—Africa produced 12.354 Mt of steel in 2000; this was more than 5% higher than that of 1999. Africa represented only 1% of world steel production. Output in Libya increased by 11.7%; Egypt, by 7.7%; and South Africa, by 2.8%. Overall, South Africa produced more than 7 Mt, or 57% of Africa's steel; Egypt, more than 2.8 Mt, or 23% of Africa's steel; and Libya, more than 1 Mt, or almost 9%.

The major development in this sector in Africa was in Egypt where Alexandria National Iron and Steel Co. began commercial production of an 80,000-t/yr direct-reduction iron plant and Suez Steel Co. opened a 600,000-t/yr-capacity steel minimill in 2000.

Consumption.—Africa accounted for 2% of global steel consumption. It consumed 15.4 Mt of finished steel products in 2000, which was an increase from 14.8 Mt in 1999 and 13.7 Mt in 1995. From 1995 to 2000, South Africa's consumption of steel products fell to 4 Mt from 4.4 Mt. Egypt's consumption increased to 5.5 Mt in 2000 from 3.7 Mt in 1995, and the demand for steel by other African countries rose to 5.8 Mt from 5.6 Mt (International Iron and Steel Institute, 2001, Apparent steel consumption—1994 to 2000, accessed November 16, 2001, at URL http://www.worldsteel.org/trends_indicators/figures_21.html).

Outlook.—African mine production of iron ore is expected to increase slightly to about 50 Mt in 2001 and to about 53 Mt by 2003. In 2001, the projected decline in crude steel output from Libya and Zimbabwe should be offset by increased steel production in Egypt and South Africa (Metal Bulletin, 2001). Proposed expansions of steel plants in Algeria, Egypt, and Libya should increase African steel production to 15.8 Mt by 2005.

Africa's consumption of finished steel is expected to increase by nearly 3% in 2001, 2% in 2002, and between 1% and 2% from 2003 to 2006. By 2006, Africa is likely to account for about 2% of world steel consumption [MEPS (International) Ltd., 2002, Global iron and steel production to 2006 [abstract], accessed April 23, 2002, at URL http://www.meps.co.uk/Global%20Tables.html).

Lead.—Production.—Africa produced 177,097 t of lead in 2000, down by less than 1% compared with output in 1999. Africa accounted for 6% of the world's total production. The lead mining sector in Africa was dominated by Morocco, which produced 82,300 t, or about 47% of Africa's output, and by South Africa, which mined 75,262 t, or about 42%. Algeria, Namibia, Nigeria, and Tunisia also mined lead ore.

Consumption.—In 2000, Africa's share of the world's lead consumption was 2%; South Africa accounted for 56% of the continent's lead consumption. Lead consumption fell to 119,400 t in 2000 compared with 127,000 t in 1999. The decline in

TABLE 6
AFRICA: HISTORIC AND PROJECTED LEAD MINE PRODUCTION, 1990-2005 1/

(Metric tons)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Algeria	1,100	1,383	1,215	818	(2/)	(2/)	(2/)
Morocco	68,800	67,708	79,900	82,300	83,000	85,000	90,000
Namibia	18,000	16,084	9,885	12,115	13,000	13,000	13,000
South Africa	69,400	88,449	80,191	75,262	50,000	50,000	40,000
Tunisia	2,970	6,601	6,589	6,602	(2/)	(2/)	(2/)
Undistributed	--	--	--	--	4,000	4,000	4,000
Total	160,000	180,000	178,000	177,000	150,000	150,000	140,000

-- Negligible or no production. e/ Estimated.

1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

2/ Included in "Undistributed."

African consumption of lead is likely to continue, particularly in South Africa where consumption for the first 7 months of 2001 was about 30% less than that of the same period in 2000 (World Bureau of Metal Statistics, 2001, p. 82).

Outlook.—The mine output of lead also was expected to decline, and little change is expected between 2001 and 2005 for refined lead output.

Manganese.—Production.—Africa produced ore containing about 2.74 Mt of manganese in 2000, which was more than 12% higher than that of 1999. Africa represented 38% of the world total. South Africa produced 1.57 Mt, or more than 57% of Africa's output, and Gabon produced 876,000 t, or about 32%.

The major development in this sector in Africa for 2000 was in Gabon where Compagnie Minière de l'Ogooué S.A.'s (Comilog) $70 million manganese ore enrichment and sintering plant in Gabon was inaugurated. The plant, which is located at Moanda, will have a production capacity of 600,000 t/yr of sintered manganese ore. In Ghana, Manganese Company Ltd.'s Nsuta-Wassaw open pit mine near Tarkwa, which has benefited from recent investment in upgrading mining equipment and optimizing mine plans, saw production increase to 895,669 t of manganese ore in 2000 from 638,937 t in 1999.

Outlook.—Mine production of manganese is expected to approach 3.6 Mt by 2003. In Gabon, Comilog's new plant will extend the life of its mine by allowing the processing of manganese fines and will provide a direct feed to Eramet's manganese ferroalloy plants. In addition, in South Africa, the Associated Manganese Mines of South Africa Ltd. (Assmang), was investing $75 million to add a new shaft complex at the Nchwaning III underground manganese mine. The new shaft was expected to be operational by late 2003. The expanded Nchwaning operation will have a run-of-mine capacity of about 2 million metric tons per year (Mt/yr) of manganese ore, this will extend its life by more than 20 years.

TABLE 7
AFRICA: HISTORIC AND PROJECTED MANGANESE MINE PRODUCTION, 1990-2005 1/

(Thousand metric tons)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Egypt	--	(3/)	10	10	10	10	10
Gabon	1,220	950	893	876	1,650	1,650	1,650
Ghana	96	85	204	287	290	290	320
South Africa	1,910	1,330	1,330	1,570	1,600	1,600	1,650
Total	3,230	2,370	2,440	2,740	3,550	3,550	3,630

-- Negligible or no production. e/ Estimated.

1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

2/ In addition to metallurgical grade manganese, Gabon, Morocco, and South Africa produce battery- and chemical-grade manganese oxide.

3/ Less that 1 unit.

Nickel.—Production.—In 2000, Africa's mine production of nickel decreased to 79,700 t from 81,100 t in 1999. Africa accounted for about 6% of world nickel mine production. South Africa produced 46% of Africa's nickel mine output; Botswana, 45%; and Zimbabwe, 10%. In 2000, South Africa's output of refined nickel increased to 29,616 t from 28,345 t in 1999.

Consumption.—Africa accounted for slightly more than 3% of the world's nickel consumption. Demand for refined nickel rose to 38,000 t in 2000 compared with 34,400 t in 1999. Within the region, South Africa, which was the dominant consumer, accounted for 99% of African nickel demand (World Bureau of Metal Statistics, 2001, p. 105).

Outlook.—Changes in refined nickel consumption and the output of nickel ore and refined nickel output in Africa are expected to be modest (World Bureau of Metal Statistics, 2001, p. 103-105). Phelps Dodge Mining Company completed a detailed feasibility study and environmental assessment of the Ambatovy nickel and cobalt laterite deposit in central Madagascar, which it discovered in 1998; it was closely monitoring the Malagasy Government's efforts to develop a new mining investment code. The Ambatovy deposit was being designed to produce 36,000 t/yr of nickel and 3,000 t/yr of cobalt. Barrick Gold Corp. was evaluating the Kabanga nickel sulfide deposit in northwestern Tanzania. The previous owner, Sutton Resources Ltd., had planned to produce about 17,000 t/yr of nickel, 1,600 t/yr of copper, and 1,200 t/yr of cobalt.

Platinum-Group Metals.—Production.—In 2000, South Africa accounted for an estimated 74% of the world's

TABLE 8
AFRICA: HISTORIC AND PROJECTED NICKEL MINE PRODUCTION, 1990-2005 1/

(Metric tons)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Botswana	23,200	18,088	33,733	34,465	20,000	20,000	20,000
South Africa	29,000	30,700	36,200	36,616	36,000	36,000	40,000
Zimbabwe	13,500	11,721	11,164	8,160	8,000	8,000	8,000
Total	66,000	60,509	81,100	79,700	64,000	64,000	68,000

e/ Estimated.
1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

production of platinum, 86% of rhodium and other PGM, and 32% of palladium. South Africa produced 206,770 kg of PGM and exported 198,944 kg valued at $3.9 billion; the country was well positioned to capitalize on a sharp increase in palladium and platinum prices.

Anglo American Platinum Corp. Ltd. (Anglo Platinum), which was the world's largest PGM producer, was undergoing a $2 billion major capital investment program to expand production of platinum to 108,862 kg by 2006 from its 2000 level of 62,200 kg. In 2000, capital expansion investment was $193 million with more than $450 million projected for 2001 (Anglo American Platinum Corp. Ltd., 2001, p. 48-51).

Impala Platinum Holdings Ltd. (Implats) held majority interests in the Impala Platinum operations, Platexco Inc., and Barplats Mines Ltd., and minority interest in the Aquarius Platinum and the Two Rivers Platinum (Pty) Ltd. joint ventures. During 2000, Implats took the first step in its plans to expand production at a rate of 10% per year. Implats planned on investing $486 million from 2000 to 2004 to maintain its in-house capacity at the 31,110-kilogram-per- year (kg/yr) level until 2030. The $230 million Winnaarshoek and the Dwars Rivier Farm projects were expected to produce 5,443 kg/yr and 3,110 kg/yr, respectively, of PGM by 2004. Barplats' Crocodile River Mine was brought into production during 2000 (Impala Platinum Holdings Ltd., 2001, p. 9-11, 35, 37; Business Day, May 30, 2001, Avmin, Implats in R551m platinum deal, accessed October 24, 2001, at URL http://www.bday.co.za/content/direct/1,3523,858927-6079-0,00.html).

During 2000, Lonmin plc, which was South Africa's third largest PGM producer, announced plans to increase production by 43% during a 7-year period to 27,060 kg/yr of platinum at a capital cost of $550 million, which they expect to cover from cash flow (Lonmin plc, 2000, p. 2).

Also in South Africa, Aquarius Platinum Ltd. had interests

TABLE 9
AFRICA: HISTORIC AND PROJECTED PLATINUM MINE PRODUCTION, 1990-2005 1/

(Kilograms)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
South Africa	87,800	102,300	121,304	114,459	130,000	130,000	135,000
Zimbabwe	21	7	479	505	520	500	500
Total	87,800	102,300	122,000	115,000	131,000	130,000	140,000

e/ Estimated.
1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

TABLE 10
AFRICA: HISTORIC AND PROJECTED PALLADIUM MINE PRODUCTION, 1990-2005 1/

(Kilograms)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
South Africa	38,300	51,000	58,164	55,818	63,000	63,000	66,500
Zimbabwe	31	17	342	366	371	350	350
Total	38,300	51,000	58,500	56,200	63,000	63,000	67,000

e/ Estimated.
1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

TABLE 11
AFRICA: HISTORIC AND PROJECTED ILMENITE MINE PRODUCTION, 1990-2005 1/

(Thousand metric tons of TiO_2)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Egypt	--	30	69	66	69	69	69
Kenya	--	--	--	--	--	--	150
Mozambique	--	--	--	--	--	--	300
Sierra Leone	33	--	--	--	--	50	50
South Africa	567	890	981	1,060	1,060	1,100	1,100
Total	600	920	1,050	1,120	1,130	1,200	1,600

-- Negligible or no production. e/ Estimated.
1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

in PGM projects that included the Kroondal Mine and the Marikana and the Everest South PGM projects in North West Province. In 2000, Kroondal Platinum Mines Ltd. produced 1,533 kg of platinum, 707 kg of palladium, and 236 kg of rhodium, all in concentrates, which were sold to Implats for refining. Kroondal Platinum entered a 50/50 joint venture with Anglo Platinum's Rustenburg Division to expand Kroondal's production to 15,550 kg/yr of PGM, which included 9,330 kg/yr of platinum, by 2002. Aquarius has decided to begin development of the $70 million Marikana project, which will produce concentrates that contain 2,924 kg of platinum, 1,483 kg of palladium, and 529 kg of rhodium to be sold to Implats (Aquarius Platinum Ltd., 2001, p. 2-9).

Northam Platinum Ltd. (Northam) of South Africa operated the Northam Mine and processing plant near Anglo Platinum's Amandelbult Section. Northam's equity partners included Mvelaphanda Platinum (22.5%) (an economic empowerment company) and Anglo Platinum (20%). During the year that ended June 30, 2001, Northam reported sales at 5,235 kg of platinum, 2,475 kg of palladium, 414 kg of rhodium, and 183 kg of gold. Construction of the concentrator for the UG2 Reef expansion project was completed in November 2000 and commissioned by January 2001 (Northam Platinum Ltd., 2001, Operational review, Annual Report for 2001, accessed October 24, 2001, at URL http://www.northam.co.za/annual_report/2001/ar_index.html).

SouthernEra Resources Ltd. of Canada began development of the $86 million Voorspoed section of its Messina Platinum Mine in South Africa in 2000; completion was expected in early 2003. The mine is scheduled to produce a total of 4,945 kg/yr of four platinum-group elements plus gold. A second ore body, the Doornvlei section, held potential for future expansion of the Messina Mine (SouthernEra Resources Limited, 2001, Projects—The Messina platinum project, accessed October 25, 2001, at URL http://www.southernera.com/messina.htm).

Outlook.—Global demand for platinum is expected to increase by about 5% in 2001; falling demand for platinum for jewelry will be more than offset by its rising use in pollution control and other industrial applications. South Africa's mine production of platinum is expected to increase by 13.6% to 130,000 kg in 2001 from 114,459 kg in 2000. A further increase to 135,000 kg is expected by 2005. Palladium production is expected to increase by 12.9% to 63,000 kg in 2001 and to 66,500 kg between 2003 and 2005.

Tin.—Consumption.—Africa's share of the world's tin consumption was about 1%. In 2000, continental consumption fell by about 7% compared with 1999 demand. South Africa accounted for 77% of the region's tin consumption (World Bureau of Metal Statistics, 2001, p. 122). Tin consumption is likely to rise slightly in 2001.

Outlook.—Tin ore and refined tin production are expected to increase owing to higher output from Nigeria (World Bureau of Metal Statistics, 2001, p. 120-122).

Titanium.—Production.—Following Australia, South Africa was the world's second largest producer of ilmenite and rutile concentrates and of titanium slag from operations at Namakwa Sands and at Richards Bay. In 2000, South Africa's production of titaniferous slag was estimated to have increased to 1.12 Mt from 1.1 Mt in 1999. Production of rutile was estimated to have remained unchanged at 100,000 t in 2000.

Outlook.—Four new titanium bearing heavy sands projects are under active consideration for development in eastern and southern Africa. The proposed projects, which represent $840 million in new investments, include the Kwale project of Tiomin Ltd. of Canada in Kenya; the Corridor Sands deposit of Southern Mining/Western Mining Corp. of Australia, which was scheduled for start-up in August 2001; the Moma project of Kenmare Resources plc of Ireland, which was scheduled for start-up in early 2003 in Mozambique; and the Iscor Ltd. project in South Africa. In Sierra Leone, the Government was encouraging Sierra Rutile Ltd. to reevaluate the feasibility of investing an estimated $100 million to reopen its large high-grade rutile mine, which closed in 1995 because of the civil war.

Zinc.—Production.—In 2000, Africa's mine output of zinc amounted to 259,775 t, which was a decrease of more than 5% from that of 1999. Africa accounted for nearly 3% of world zinc mine production. Morocco, which was the leading producer of zinc in Africa, accounted for 40% of the continent's zinc mine output; South Africa, 24%; and Namibia and Tunisia, about 16% each. South Africa produced about 1% of global zinc smelter output in 2000.

Outlook.—During 2000, six zinc projects were underway that could make Africa a significant player in world zinc markets. Four of the six projects, Anglo American plc's Skorpion project in Namibia, its Black Mountain expansion project, and its Gamsberg project in South Africa and Metorex Ltd.'s Perkoa zinc project in Burkina Faso would require a total investment of around $1.5 billion. These projects are expected to triple Africa's zinc production from its 1998 level of 280,875 t. The other two proposed projects are less certain. Billiton's proposed $580 million 250,000-t/yr zinc smelter at Coega, South Africa (near Port Elizabeth), has been put on hold by the withdrawal of Billiton's partner and delays in approving the Coega Port development. In Congo (Kinshasa), the joint venture between Anglo American and American Mineral Fields Inc. has been conducting a feasibility study on reopening the Kipushi Mine,

TABLE 12
AFRICA: HISTORIC AND PROJECTED ZINC MINE PRODUCTION, 1990-2005 1/

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Algeria	4,160	7,174	9,808	10,452	12,000	12,000	13,000
Morocco	18,800	79,947	111,703	105,107	123,000	135,000	135,000
Namibia	37,700	30,209	35,140	40,266	32,000	80,000	180,000
South Africa	75,000	70,241	69,733	62,703	60,000	40,000	40,000
Tunisia	3,960	44,244	49,066	41,247	41,000	39,000	40,000
Total	140,000	232,000	275,000	260,000	270,000	310,000	410,000

e/ Estimated.

1/ Estimated data and totals are rounded to no more than three signficant digits; may not add to totals shown.

which would produce 200,000 t/yr of zinc and 30,000 t/yr of copper when political and market conditions are more favorable.

The mine output of zinc is expected to increase significantly between 2001 and 2005. Production will decline in South Africa after the Perring Mine is closed but will expand significantly in Namibia with the opening of the Skorpion Mine, which is expected to open in 2003 and to reach full production by 2005.

Industrial Minerals

Cement.—Africa's production of cement increased by 5.8% to an estimated 71.5 Mt. This represents 4% of world production. Egypt, which produced about 34% of Africa's cement, was the largest producer; its output increased to 24.1 Mt in 2000 from 23.3 Mt in 1999.

Diamond.—Africa's output of diamond represents 50% of world production. In 2000, mine output decreased by less than 1% to an estimated 61.7 million carats. Botswana produced about 39% of Africa's diamonds; its output increased by nearly 6% to 24.218 million carats. Congo (Kinshasa) was the second leading producer of diamonds in Africa in 2000 with 17.7 million carats, or almost 29%. South Africa was the third leading producer of diamonds in 2000 with 10.8 million carats, or nearly 18%. In 2000, 80% of Botswana's diamond production was gem quality; South Africa, 40%; and Congo (Kinshasa), 20%.

The major development in the diamond sector in 2000 was the completion of the Orapa Mine expansion in Botswana; with the expansion, Debswana Diamond Co. (Pty.) Ltd. could increase production to 12 million carats in 2001. In Namibia, Namdeb Diamond Corp. (Pty.) Ltd. accounted for 86% of 1.54 million carats of Namibian national output. Recent entrants, such as Afri-Can Marine Minerals Corp. (formerly Nora Exploration Inc.), Diamond Fields International Ltd. of Canada, Namibian Minerals Corp. (Namco), and Trans Hex International Ltd., were aggressively developing new offshore resources with innovative submarine mining technologies. During 2000, Namco, which was Namibia's second largest diamond producer, invested $50 million in expanding its marine mining capacity.

The international community, encouraged by formal United Nations (UN) sanctions and monitoring, continued its efforts to control the illegal mining and export of so-called conflict or blood diamonds, which were being used to finance civil wars in Angola and Sierra Leone. In Angola, officially reported production increased to 4.3 million carats in 2000 from 3.7 million carats in 1999. The value of diamond production in 2000 was reported to be at least $1.1 billion; 69% of diamond produced under Angolan Government control came from nine state-owned mines at a value of $398.5 million, and 31% at a value of $347.6 million was attributed to artisanal miners (United Nations Security Council, 2001, p. 16). Alleged smuggling by the National Union for the Total Independence of Angola (UNITA) and other sources was estimated to be $350 million in 2000.

United Nations Security Council Resolution 1306 (2000) expressed UN concern over the role the mining and smuggling of illicit diamonds by the rebel forces played in funding the conflict in Sierra Leone and asked all states to work to prohibit the flow of rough diamonds from Sierra Leone into such neighboring countries as Liberia. The UN also requested Sierra Leone to put in place a Certificate of Origin Program for the export of rough diamonds.

Fertilizers.—In 1999, the last year for which data are available, Africa's apparent consumption of phosphate fertilizers increased to 992,600 t compared with 937,600 t in 1998, and that of nitrogenous fertilizers rose to 2.4 Mt from 2.35 Mt. Potash consumption fell to 483,300 t from 492,700 t. Africa accounted for about 3% of the world's nitrogenous fertilizer and potash consumption and 2% of world phosphate fertilizer demand (International Fertilizer Industry Association, 2001, Nitrogen, phosphate and potash statistics, accessed November 16, 2001, at URL http://www.fertilizer.org/ifa/statistics/IFADATA/dataline.asp). Africa consumed 18.3 Mt of sulfuric acid in 1999 and accounted for 11% of global sulfuric acid

TABLE 13
AFRICA: HISTORIC AND PROJECTED DIAMOND MINE PRODUCTION, 1990-2005 1/

(Thousand carats)

Country	1990	1995	1999	2000	2005 e/
Angola	1,130	2,900	3,732	4,349	6,000
Botswana	17,400	16,802	22,898	24,218	26,000
Central African Republic	381	530	530	530	(2/)
Congo (Kinshasa)	19,400	22,024	20,116	17,700	17,000
Cote d'Ivoire	12	75	398	320	(2/)
Gabon	1	1	1	1	(2/)
Ghana	650	632	680	920	(2/)
Guinea	127	365	550	450	(2/)
Liberia	100	150	200	170	(2/)
Namibia	763	1,382	1,633	1,542	2,000
Sierra Leone	78	214	600	350	(2/)
South Africa	8,710	9,683	10,022	10,805	14,000
Tanzania	85	50	235	354	(2/)
Zimbabwe	--	204	45	17	(2/)
Other	XX	XX	XX	XX	2,000
Total	48,800	55,000	61,600	61,700	65,000

-- Zero. e/ Estimated. XX Not applicable.

1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

2/ Included with "Other."

consumption.

Gemstones.—In 2002, African Gem Resources Ltd. (Afgem) expected to start mining tanzanite in an area in Tanzania that had been worked by artisanal miners. Afgem proposed to develop a formal mining operation that would reach production levels of 1.5 million carats per year by 2005. Afgem anticipated that mining the area's tanzanite resource would take at least 20 years. In Madagascar, the discovery of new ruby deposits in early 2001 was expected to lead to higher ruby production and exports.

Graphite.—Africa's production of graphite was 27,000 t in 2000 and was unchanged from that of 1999. This represents 4% of world production. Madagascar and Zimbabwe were the only significant producers of graphite in Africa and their output was 15,000 t and 12,000 t, respectively.

Phosphate Rock.—Production.—In 2000, Africa's production of phosphate rock decreased by 3.6% to about 38 Mt compared with 1999 output. This level of production represented about 29% of world output. Morocco, which mined about 56% of Africa's phosphate rock, was the largest producer; its output, however, decreased to about 21.5 Mt in 2000 from almost 22.8 Mt in 1999.

Outlook.—In 2001, the production of phosphate rock is likely to rise in Algeria and Morocco and fall in South Africa, Senegal, Togo, and Tunisia.

Mineral Fuels

Coal.—Production.—Africa's production of coal decreased by about 1% to 228.9 Mt. This represented about 5% of world production. South Africa produced more than 97% of Africa's coal; its output increased to 228.9 Mt in 2000 from about 223.5 Mt in 1999.

Consumption.—Africa accounted for about 4% of the world's coal consumption.

Natural Gas.—Production.—In 2000, Africa's production of natural gas was 145.7 trillion cubic meters, which was an increase of 9% from 1999. This represents nearly 6% of world production. Algeria produced about 69% of Africa's natural gas; its dry gas output increased to 100 trillion cubic meters compared with 97.2 trillion cubic meters in 1999.

In Mozambique, the stalled development of the Pande and the Temane gasfields was revived in 2000 when Sasol Ltd. and the Government signed agreements to build a natural gas pipeline to South Africa. Nigeria continued the economic exploitation of its natural gas resources. The third train of the $3.8 billion liquefied natural gas (LNG) plant at Bonny was commissioned in September 2000.

Consumption.—The African continent consumed slightly more than 2% of the world's natural gas. African consumption rose to 58.9 billion cubic meters in 2000 compared with 52.1 billion cubic meters in 1999 and 44.8 billion cubic meters in 1995 (British Petroleum plc, 2001, p. 26).

Outlook.—Successful drilling programs in Algeria, Egypt, Nigeria, and Tunisia and several proposed natural gas facilities and infrastructure projects should lead to more development of African natural gas resources. African production of natural gas is projected to be almost 30% higher in 2005 than it was in 2000. In Egypt, four proposed LNG projects are being considered. In Mozambique, production from the Temane gasfield is expected to reach about 1 billion cubic meters in 2004.

In Namibia, the $1 billion Kudu Gas project to pipe natural gas from the Kudu Oil Fields to South Africa is scheduled to start in 2005 (U. S. Department of Commerce, National Trade Data Bank, August 18, 1999, Namibia Gas fields project, accessed January 15, 2001, at URL http://www.tradeport.org/ts/countries/namibia/mrr/mark0007.html).

With the completion of the planned fourth and fifth LNG production trains in 2005, Nigeria's Bonny LNG facility will have the capacity to produce 16.8 Mt/yr of LNG, 2 Mt/yr of liquefied petroleum gas, and 1 Mt/yr of condensate. A consortium led by Chevron Nigeria Ltd. has committed to build

TABLE 14
AFRICA: HISTORIC AND PROJECTED DRY NATURAL GAS PRODUCTION, 1990-2005 1/

(Million cubic meters)

Country	1990	1995	1999	2000	2001 e/	2003 e/	2005 e/
Algeria	48,500	58,100	97,151	100,092	100,000	110,000	120,000
Angola	538	560	560	560	560	560	3,000
Congo (Kinshasa)	--	--	--	--	--	60	60
Cote d'Ivoire	--	36	800	800	1,200	1,500	1,200
Egypt	7,900	12,536	17,800	21,000	20,000	31,000	29,000
Equatorial Guinea	--	--	83	98	800	1,350	1,350
Ethiopia	--	--	--	--	--	--	100
Gabon	150	150	99	99	104	103	100
Libya	6,200	6,345	6,200	6,100	6,000	7,200	17,000
Morocco	37	22	39	39	37	36	37
Mozambique	--	--	55	55	60	60	1,000
Nigeria	3,230	5,000	7,000	13,000	17,000	21,000	25,000
Senegal	110	110	56	56	50	41	33
South Africa	--	1,980	2,039	2,088	2,200	2,000	1,900
Sudan	--	--	--	10	10	10	10
Tanzania	--	--	--	--	--	400	800
Tunisia	200	250	1,450	1,750	1,750	1,900	2,200
Total	66,900	85,100	133,000	146,000	150,000	180,000	200,000

-- Negligible or no production. e/ Estimated.

1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

the West African Gas Pipeline (WAGP), but the proposed 2002 inauguration of the pipeline has been pushed back to 2006. The $400 million WAGP project will include the construction of an offshore gas pipeline from the Niger Delta to Ghana. The pipeline will supply Nigerian natural gas that is currently (2000) being flared to powerplants in Benin, Ghana, and Togo (allAfrica.com, November 13, 2000, West African gas pipeline co-operating for energy security, accessed January 20, 2001, at URL http://allafrica.com/stories/200011130108.html).

The Songas natural gas project in Tanzania is expected to start production in 2003.

Petroleum.—Production.—Africa's production of crude petroleum increased by 2.6% to about 2.8 billion barrels, which represented more than 10% of world production. Nigeria, which produced 28% of Africa's crude oil, remained the largest producer on the continent; its output increased to 783 million barrels (Mbbl) in 2000 compared with 777 Mbbl in 1999. Libya was the second leading producer of crude oil in Africa in 2000 with 538 Mbbl, or about 19% of total African production. Algeria was third, with 476.3 Mbbl; Egypt was fourth, with 290 Mbbl; and Angola was fifth, with slightly more than 272 Mbbl.

There were several major developments in the hydrocarbon sector in 2000. In Angola, the $400 million Kuito floating production storage and offloading vessel (FPSO) reached its full capacity of 100,000 barrels per day (bbl/d) (Oil Online, November 2, 1999, Kuito kicks off for Angola, accessed January 20, 2001, at URL http://www.oilonline.com/news_spotlight_offshore_kuito110299.html). The $3 billion Girassol Field produced its first oil in 2000. In October 2000, Exxon Mobil Corp. of the United States began construction of the Chad-Cameroon Petroleum Development and Pipeline project in west-central Africa in conjunction with its partners Petroliam Nasional Bhd. of Malaysia and Chevron Corp. of the United States. The project will develop oilfields in southern Chad and transport the crude oil to the coast of Cameroon for export to world markets. The $3.5 billion project should produce about 225,000 bbl/d, or 1 billion barrels (Gbbl) during its 30-year life (ExxonMobil, October 18, 2000, ExxonMobil affiliate commences major African development project, accessed January 20, 2001, at URL http://www.exxon.mobil.com/em_newsrelease). The International Development Association approved a $24 million loan for environmental management and monitoring of the project, the International Finance Company approved a $100 million loan to the pipeline companies, and the World Bank approved a $93 million loan to finance the interests of the Governments of Cameroon and of Chad in the field development and pipeline projects.

Consumption.—African consumption of crude oil increased to about 904 Mbbl from 894 Mbbl in 1999 and 807 Mbbl in 1995; Africa accounted for about 3% of the world's petroleum consumption (British Petroleum plc, 2001, p. 10).

Outlook.—Africa's production of crude petroleum could increase to about 3.9 Gbbl in 2005. This would be an increase of almost 39% compared with Africa's production of petroleum in 2000.

In Angola, the Girassol Field was expected to reach full capacity of 200,000 bbl/d during 2001. The $3.1 billion Kizomba-A FPSO is being built by an ExxonMobil consortium and will produce 250,000 bbl/d from the Chocahlo and the Hunga Fields by 2004. The Kizomba B project will develop the Dikanza and the Kisanje Fields and will be operated by Esso Exploration Angola Ltd. (Esso) (Oil Online, August 14, 2000, Next mega-projects set for takeoff, accessed December 20, 2000, at URL http://www.oilonline.com/news_spotlight_offshore_westafrica081400.html). The large capital costs involved will likely lead to sequential development rather than parallel. Angola's production of crude petroleum is expected to increase to 475 million barrels per year (Mbbl/yr) by 2002 and to 730 Mbbl/yr by 2006.

In Nigeria, Shell Petroleum Development announced plans to develop the Bonga deepwater oilfield. The $1.8 billion Bonga FPSO will produce 225,000 bbl/d by 2003 (Adrian Cottrill, July 1, 2000, Next mega-projects set for takeoff, accessed December 20, 2000, at URL http://www.oilonline.com/news/features/oe/

TABLE 15

AFRICA: HISTORIC AND PROJECTED CRUDE PETROLEUM, INCLUDING CONDENSATE, PRODUCTION, 1990-2005

(Thousand 42-gallon barrels)

Country	1990	1995	1999	2000	2002 e/	2003 e/	2005 e/
Algeria	444,000	438,730	457,158	476,288	479,000	550,000	600,000
Angola	174,000	232,800	279,590	272,290	475,000	475,000	475,000
Benin	1,416	654	--	--	--	--	--
Cameroon	64,600	39,400	47,000	47,000	29,000	27,000	24,000
Chad	--	--	--	--	1	30,000	84,000
Congo (Brazzaville)	58,800	63,875	93,951	96,700	93,000	92,000	90,000
Congo (Kinshasa)	10,600	10,087	8,650	10,300	9,700	9,400	9,800
Cote d'Ivoire	770	2,000	10,000	10,000	2,000	3,000	2,600
Egypt	319,000	335,800	311,000	290,000	230,000	210,000	220,000
Equatorial Guinea	--	2,300	33,000	39,000	58,000	65,000	90,000
Gabon	100,000	133,000	124,500	124,500	124,000	120,000	115,000
Ghana	--	--	2,190	2,200	2,100	2,300	2,200
Libya	502,000	509,175	520,000	538,000	530,000	650,000	700,000
Morocco	114	36	35	35	35	35	35
Nigeria	660,000	740,000	777,000	783,000	800,000	1,000,000	1,350,000
Senegal	8	2	1	1	--	--	--
South Africa	--	--	5,493	6,606	6,400	5,000	3,000
Sudan	--	730	19,000	69,000	70,000	88,000	89,000
Tunisia	36,500	32,690	30,960	28,207	24,000	22,000	18,000
Total	2,370,000	2,540,000	2,720,000	2,790,000	2,900,000	3,400,000	3,900,000

-- Negligible or no production. e/ Estimated.

1/ Estimated data and totals are rounded to no more than three significant digits; may not add to totals shown.

20000701.next_meg.66.asp). The development of six deepwater oilfields by 2005 at a cost of $10 billion will access 4 Gbbl of oil equivalent Nigerian reserves, which includes 70.8 billion cubic meters of natural gas. Nigeria's production is expected to increase to 1 Gbbl by 2003, and to 1.35 Gbbl by 2005.

Uranium.—Africa's production of uranium decreased by 13.2% to 7,114 t. This represented 17% of world production. Namibia, which was Africa's largest producer, produced 45% of Africa's uranium; its output increased to 3,201 t in 2000 from 3,171 t in 1999. Niger was the second leading producer of uranium in Africa with 2,898 t, or almost 41% of African uranium production in 2000. South Africa was the third leading producer of uranium with 1,015 t, or about 14%.

Geothermal Energy.—The prospect of economic development of geothermal energy power sources in Africa along the East African Rift Valley was drawing increasing interest from investors and local Governments. The geothermal potential of the Ethiopian Rift has been estimated to be 700 megawatts (MW). The Aluto-Langano geothermal powerplant in the lakes district has a capacity of 7.3 MW; the Government planned to increase capacity at the plant to 30 MW. From 2000 to 2005, Kenya's geothermal generating capacity was expected to increase by 128 MW; geothermal capacity was expected to increase by 531 MW by 2017. In Djibouti, a joint venture between Geothermal Development Associates of Nevada and Electricité de Djibouti proposed to build a geothermal powerplant near Assal.

Hydroelectric Energy.—In Ethiopia and Uganda, expansions of the country's hydroelectric power capacity were underway. In Kenya, new thermal powerplants were being built to reduce Kenya's vulnerability to droughts, which affect its ability to generate electric power from existing hydroelectric dams.

Trade Review and Outlook

In 2000, the value of African exports increased to $155.4 billion from $128.1 billion in 1999 and $120.4 billion in 1998. Foreign trade has increased to 60% of the value of African GDP in 1999 compared with 44.5% in 1980. During the same period, exports increased to 23.7% of GDP from 17.6%. From 1995 to 1999, intraregional exports accounted for an average of 9.4% of all African exports and 0.4% of North African exports. The European Union absorbed about 40% of African exports (Blavy, 2001, p. 16-17; International Monetary Fund, 2001, p. 235). Where data is available on the value of mineral trade, they is discussed in the individual country chapters in this book. Country chapters also are available at URL http://minerals.usgs.gov/minerals/pubs/country/africa.html.

After incurring current account deficits of $15.5 billion in 1999 and $20.6 billion in 1998, Africa recorded a regional surplus of $2.1 billion in 2000. Most of the improvement in Africa's trade position was attributable to rising oil prices; oil-exporting countries had an average surplus of 9.7% of GDP in 2000. Africa's petroleum trade surplus increased to $47.3 billion in 2000 from $25.5 billion in 1999 and $19.3 billion in 1998. Oil-importing countries had an average deficit of 2.7% of GDP; many sub-Saharan countries, however, ran large deficits because of high oil prices, weak prices for nonfuel commodities, and debt service costs. Africa's external debt fell to $183.4 billion in 2000 from $226.9 billion in 1999 (International Monetary Fund, 2001, p. 44, 235, 263).

In 2000, Africa accounted for 60% of the world's exports of phosphoric acid; phosphate rock, 46%; crude petroleum, 16%; petroleum products, 8%; and nearly 5% of the world's aluminum exports. South Africa accounted for 73% of African aluminum exports and West African countries accounted for 60% of African crude petroleum exports (British Petroleum plc, 2001, p. 19; World Bureau of Metal Statistics, 2001, p. 11).

The value of African exports was expected to rise by 0.3% in 2001 and by 2.3% in 2002. The trade surplus for petroleum was expected to fall to $45 billion in 2001 and to $41.7 billion in 2002. The projected current account deficit of $3.9 billion in 2001 is expected to increase to $6.4 billion in 2002. Debt relief initiatives by the IMF and World Bank should result in further declines in Africa's external debt, which was projected to fall by nearly 25% by 2006 (International Monetary Fund, 2001, p. 235, 263).

Environment

Deforestation has been a significant environmental issue in Africa. From 1990 to 2000, forest cover decreased at a rate of 0.8% per year compared with the global rate of 0.2% per year. The most rapid deforestation occurred in Burundi, which lost forest cover at a rate of 9% per year; Comoros, 4.3%; Rwanda, 3.9%; and Niger, 3.7% (Food and Agricultural Organization of the United Nations, 2001, p. 31, 34). The economic losses from deforestation, such as soil erosion and desertification, have led to plans to increase hydroelectric power capacity in Ethiopia and Uganda and discussions of exploiting the peat resources of Burundi.

The WAGP project could also mitigate the effects of deforestation in Africa and reduce the emissions of greenhouse gases. Some of the natural gas that is currently (2000) being flared by Nigeria will be exported to Togo, Benin, and Ghana; these countries have deforestation rates of 3.4%, 2.3%, and 1.7%, respectively (Food and Agricultural Organization of the United Nations, 2001, p. 31). The Government of Nigeria has committed to ending the flaring of natural gas by 2010, which will also lead to decreased pollution.

In Tanzania, pollution from acid mine and rock drainage at abandoned mine sites led the Government to seek financing from the Nordic Development Fund to mitigate these problems. Environmental damage attributed to the artisanal mining of sapphires in Madagascar and tantalum in Congo (Kinshasa) was drawing increasing public attention. Concerns about potential environmental impacts delayed the exploitation of natural gas in Tanzania and titanium sands deposits in Kenya and Madagascar.

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TABLE 16
AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES, 2000 1/

(Thousand metric tons gross weight unless otherwise specified)

Country	Aluminum	Bauxite	Cement e/	Chromite	Coal, anthracite and bituminous	Cobalt, mine Co content (metric tons)
Algeria	--	--	8,300	--	--	--
Angola	--	--	350	--	--	--
Benin	--	--	450	--	--	--
Botswana	--	--	--	--	950 e/	319
Burkina Faso	--	--	50	--	--	--
Burundi	--	--	--	--	--	--
Cameroon	95	--	500	--	--	--
Central African Republic	--	--	--	--	--	--
Chad	--	--	--	--	--	--
Congo (Brazzaville)	--	--	20	--	--	--
Congo (Kinshasa)	--	--	96	--	--	7,000
Cote d'Ivoire	--	--	650	--	--	--
Egypt	200	--	24,143	--	400 e/	--
Equatorial Guinea	--	--	--	--	--	--
Eritrea	--	--	45	--	--	--
Ethiopia	--	--	880	--	--	--
Gabon	--	--	200	--	--	--
Ghana	142	504	1,950	--	--	--
Guinea	--	15,000	250	--	--	--
Kenya	2	--	1,071	--	--	--
Liberia	--	--	15	--	--	--
Libya	--	--	3,000	--	--	--
Madagascar	--	--	48	122	--	--
Malawi	--	--	198	--	45	--
Mali	--	--	10	--	--	--
Mauritania	--	--	50	--	--	--
Morocco	--	--	7,200	--	29	1,305
Mozambique	54	8	310	--	16	--
Namibia	--	--	150	--	--	--
Niger	--	--	30	--	158	--
Nigeria	--	--	2,500	--	35 e/	--
Rwanda	--	--	70	--	--	--
Senegal	--	--	1,000	--	--	--
Sierra Leone	--	--	100	--	--	--
Somalia	--	--	--	--	--	--
South Africa	676	--	8,991	6,621	222,890	580
Sudan	--	--	300	10 e/	--	--
Swaziland	--	--	--	--	380	--
Tanzania	--	--	833	--	35	--
Togo	--	--	560	--	--	--
Tunisia	--	--	5,409	--	--	--
Uganda	--	--	380	--	--	411
Zambia	--	--	380	--	168	4,600
Zimbabwe	--	--	1,000	725	3,808	126
Total 2/	1,169	15,500	71,500	7,480	228,900	14,000
World total	24,000	135,000	1,640,000	14,400	4,530,000	33,300
Share of world total	5%	11%	4%	52%	5%	42%
United States	3,668	NA	89,510	--	1,073,612	--

See footnotes at end of table.

TABLE 16--Continued
AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES, 2000 1/

(Thousand metric tons gross weight unless otherwise specified)

Country	Copper, mine Cu content	Diamond e/ 3/ (thousand carats)	Gold e/ (kilograms)	Graphite	Iron ore	Lead, mine Pb content (metric tons)
Algeria	--	--	--	--	1,645	818
Angola	--	4,349	--	--	--	--
Benin	--	--	500	--	--	--
Botswana	38	24,218	4	--	--	--
Burkina Faso	--	--	1,000	--	--	--
Burundi	--	--	1,500	--	--	--
Cameroon	--	--	1,000	--	--	--
Central African Republic	--	530	100	--	--	--
Chad	--	--	120	--	--	--
Congo-Brazzaville	--	--	10	--	--	--
Congo-Kinshasa	21	17,700	52	--	--	--
Cote d'Ivoire	--	320	3,154	--	--	--
Egypt	--	--	--	--	2,500	--
Equatorial Guinea	--	--	--	--	--	--
Eritrea	--	--	500	--	--	--
Ethiopia	--	--	5,177	--	--	--
Gabon	--	1	70	--	--	--
Ghana	--	920	72,080	--	--	--
Guinea	--	450	13,300	--	--	--
Kenya	--	--	990	--	--	--
Liberia	--	170	1,000	--	--	--
Libya	--	--	--	--	--	--
Madagascar	--	--	9	15	--	--
Malawi	--	--	--	--	--	--
Mali	--	--	25,000	--	--	--
Mauritania	--	--	--	--	10,400	--
Morocco	7 e/	--	334	--	6	82,300
Mozambique	--	--	23	--	--	--
Namibia	19	1,542	2,456	--	--	12,115
Niger	--	--	1,000	--	--	--
Nigeria	--	--	10	--	--	--
Rwanda	--	--	10	--	--	--
Senegal	--	--	550	--	--	--
Sierra Leone	--	350	30	--	--	--
Somalia	--	--	--	--	--	--
South Africa	137	10,805	430,778	--	33,707	75,262
Sudan	--	--	6,000	--	--	--
Swaziland	--	--	--	--	--	--
Tanzania	--	354	15,060	--	--	--
Togo	--	--	--	--	--	--
Tunisia	--	--	--	--	182	6,602
Uganda	--	--	56	--	5	--
Zambia	241	--	600	--	--	--
Zimbabwe	2	17	22,070	12	451	--
Total 2/	465	61,700	605,000	27	48,900	177,100
World total	13,200	118,000	2,550,000	602	1,060,000	3,100,000
Share of world total	4%	52%	24%	4%	5%	6%
United States	1,445	(4/)	341,000	--	63,089	468,000

See footnotes at end of table.

TABLE 16--Continued
AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES, 2000 1/

(Thousand metric tons gross weight unless otherwise specified)

Country	Manganese, mine Mn content	Petroleum, crude (thousand barrels)	Phosphate rock e/ (gross weight)	Steel, crude e/	Uranium, concentrate U_3O_8 (metric tons)	Zinc, mine Zn content (metric tons)
Algeria	--	476,288	877	842	--	10,452
Angola	--	272,290	--	--	--	--
Benin	--	--	--	--	--	--
Botswana	--	--	--	--	--	--
Burkina Faso	--	--	--	--	--	--
Burundi	--	--	--	--	--	--
Cameroon	--	47,000	--	--	--	--
Central African Republic	--	--	--	--	--	--
Chad	--	--	--	--	--	--
Congo (Brazzaville)	--	96,700	--	--	--	--
Congo (Kinshasa)	--	10,300	--	--	--	--
Cote d'Ivoire	--	10,000 e/	--	--	--	--
Egypt	10 e/	290,000	1,020 e/	2,820	--	--
Equatorial Guinea	--	39,000	--	--	--	--
Eritrea	--	--	--	--	--	--
Ethiopia	--	--	--	--	--	--
Gabon	876	124,500	--	--		--
Ghana	287	2,200	--	75	--	--
Guinea	--	--	--	--	--	--
Kenya	--	--	--	25	--	--
Liberia	--	--	--	--	--	--
Libya	--	538,000	--	1,055	--	--
Madagascar	--	--	--	--	--	--
Malawi	--	--	--	--	--	--
Mali	--	--	--	--	--	--
Mauritania	--	--	--	--	--	--
Morocco	--	35 e/	21,459 5/	5	--	105,107
Mozambique	--	--	--	--	--	--
Namibia	--	--	--	--	3,201	40,266
Niger	--	--	--	--	2,898	--
Nigeria	--	783,000	--	--	--	--
Rwanda	--	--	--	--	--	--
Senegal	--	1 e/	2,000	--	--	--
Sierra Leone	--	--	--	--	--	--
Somalia	--	--	--	--	--	--
South Africa	1,570	6,606	2,779	7,019	1,015	62,703
Sudan	--	69,000	--	--	--	--
Swaziland	--	--	--	--	--	--
Tanzania	--	--	--	--	--	--
Togo	--	--	1,400	--	--	--
Tunisia	--	28,207	8,339	237	--	41,247
Uganda	--	--	--	7	--	--
Zambia	--	--	--	--	--	--
Zimbabwe	--	--	110	269	--	--
Total 2/	2,740	2,790,000	38,000	12,354	7,114	259,775
World total	7,280	27,100,000	133,000	846,000	41,000	8,730,000
Share of world total	38%	10%	29%	1%	17%	3%
United States	--	2,125,030	38,618	102,000	1,717	829,000

-- Zero. e/ Estimated. p/ Preliminary.

1/ Table includes data available through October 2001.

2/ May not add to totals shown because of independent rounding.

3/ Excluding synthetic diamond.

4/ Less than ½ unit.

5/ Includes production from Western Sahara.

TABLE 17
AFRICA: SUMMARY OF PROPOSED INVESTMENT BY MINERAL COMMODITY, 2000-2007 1/

(Million dollars)

Commodity	Investment
Metals:	
Base metals	
Ferrous metals	
Ferroalloys (Cr, Mn, V)	570
Iron and steel	2,550
Nickel	1,700
Total	4,820
Nonferrous metals	
Aluminum and magnesium	2,300
Copper and cobalt	4,850
Zinc	2,400
Total	9,550
Grand total	14,300
Gold	4,550
Platinum-group metals	3,700
Titanium mineral concentrates (TiO_2)	1,800
Industrial minerals:	
Coal	1,030
Diamonds	650
Other	580
Grand total	26,600
Mineral fuels, oil and gas	44,500

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Geological Survey compilation from published company plans.

TABLE 18
AFRICA: 2000 GROSS DOMESTIC PRODUCT AT PURCHASING POWER PARITY

Country	Gross domestic product (billion dollars)	Population (millions)
Algeria	158.68	30.29
Angola	23.64	13.13
Benin	9.78	6.17
Botswana	16.76	1.65
Burkina Faso	14.19	11.54
Burundi	4.79	6.36
Cameroon	34.65	14.88
Cape Verde	1.76	0.43
Central African Republic	5.98	3.72
Chad	8.26	7.89
Comoros	0.90	0.71
Congo (Brazzavile)	5.60	3.02
Congo (Kinshasa)	37.55	50.95
Cote d'Ivoire	33.09	16.40
Djbouti	1.85	0.63
Egypt	247.85	63.98
Equatorial Guinea	2.33	0.46
Eritrea	NA	3.67
Ethiopia	37.31	63.49
Gabon	9.21	1.21
Gambia, The	2.33	1.39
Ghana	38.41	18.41
Guinea	16.81	8.15
Guinea-Bissau	1.28	1.12
Kenya	40.87	30.67
Lesotho	3.85	2.14
Liberia	NA	2.91
Libya	82.84	5.29

See footnote at end of table.

TABLE 18--Continued
AFRICA: 2000 GROSS DOMESTIC PRODUCT AT PURCHASING POWER PARITY

Country	Gross domestic product (billion dollars)	Population (millions)
Madagascar	17.14	15.97
Malawi	9.35	11.31
Mali	9.49	11.35
Mauritania	5.51	2.67
Mauritius	14.43	1.19
Morocco	112.37	28.71
Mozambique	18.04	17.69
Namibia	10.30	1.82
Niger	10.87	10.83
Nigeria	130.26	115.22
Rwanda	7.36	7.61
Sao Tome & Principe	0.19	0.14
Senegal	20.41	9.52
Seychelles	1.00	0.08
Sierra Leone	2.18	4.46
Somalia	NA	8.78
South Africa	364.35	43.69
Sudan	60.24	31.10
Swaziland	4.13	0.93
Tanzania	22.45	35.12
Togo	7.69	4.53
Tunisia	62.66	9.56
Uganda	32.04	22.21
Zambia	10.87	10.72
Zimbabwe	29.29	12.63

NA Not available.

Sources: International Monetary Fund and the United Nations.

TABLE 19
SELECTED SIGNIFICANT EXPLORATION SITES IN AFRICA FOR 2000

Location	Type 1/	Site	Commosity	Company	Resource notes 2/	Exploration notes 3/
Burkina Faso	E	Essakan	Gold	Coronation Int'l. Mining Corp.	Data not released	Extensive drilling.
Do.	F	Kalsaka	do.	Cliff Mining plc	21 metric tons gold	Feasibility drilling.
Do.	F	Youga	do.	Ashanti Goldfields Corp. Ltd.	Data not released	Do.
Ghana	P	Bogoso	do.	Golden Star Resources Ltd.	Data not released	Extensive drilling.
Do.	E	Chirano	do.	Red Back Mining NL	32 metric tons gold	Do.
Do.	F	Ntotoroso	do.	Moydow Mines International Inc.	64 metric tons gold	Feasibility study ongoing.
Do.	F	Yamfo-Sefwi	do.	Normandy Mining Ltd.	168 metric tons gold	Extensive drilling.
Mali	P	Morila/Loulo	do.	Randgold Resources Ltd.	+187 metric tons gold	Do.
Do.	E	Tabakoto	do.	Nevsun Resources Ltd.	Data not released	Do.
Mauritania	E	Maqteir	Diamond	Dia Met Minerals Ltd.	Data not released	New diamond district.
Mozambique	F	Corridor Sands	Heavy minerals	Southern Mining Corp.	8.7 million metric tons heavy minerals	Feasibility study ongoing.
Namibia	F	Luderitz/Sea Diamonds	Diamond	Diamond Fields International Ltd.	1.1 million carats diamond	Do.
Niger	E	Samira Hill/Libiri	Gold	Etruscan Enterprises Ltd.	24 metric tons gold	Extensive drilling.
South Africa	D	Richards Bay area	Heavy minerals	Iscor Ltd.	+4 million metric tons heavy minerals	Development approved.
Tanzania	E	Bulyanhulu South	Gold	Pangea Goldfields Inc.	Data not released	Extensive drilling.
Do.	E	Golden Ridge	do.	do.	90 metric tons gold	Do.
Do.	E	Tulakawa	do.	do.	52 metric tons gold	Do.

1/ D – Approved for development; E – Active exploration; F – Feasibility work ongoing/completed; P – Exploration at producing site.

2/ Resources reported where available based on data from various public sources. Data have not been verified by the U.S. Geological Survey.

3/ Sites where extensive (more than 10,000 meters) drilling or significant (more than $4 million) expenditures have been reported.

THE MINERAL INDUSTRY OF

ALGERIA

By Philip M. Mobbs

For the Algerian minerals sector, 2000 was another year of change. The Government debated various revisions to the mining code and proposed to allow foreign investors to develop mineral deposits held by the national mining companies. It also continued the reorganization of the state-owned oil and gas company Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH) and proposed to open the oil and gas sector to competition between public and private companies (Middle East Economic Digest, 2001b). The national electricity production, transmission, and distribution and natural gas transmission and distribution company Etablissement Public à Caractère Industriel et Commercial (Sonelgaz) announced that local and foreign investors would be allowed to generate and sell electricity (Richards, 2001).

Natural gas and petroleum dominated the minerals sector and accounted for about 30% of the gross domestic product (U.S. Energy Information Administration, January 2001, Algeria—General background, Country Analysis Briefs, accessed May 11, 2001, at URL http://www.eia.doe.gov/emeu/cabs/algeria2.html). Of the nonfuel minerals produced, helium, iron ore, mercury, and phosphate rock were the most notable.

Government Policies and Programs

With further liberalization of the electrical power generation, mining, crude oil, and natural gas sectors proposed, the Government anticipated increased interest in mineral development and replacement of the limited state funds earmarked for the natural resource sector by project-dedicated domestic and foreign investment. The Government proposed to manage the minerals sector through two new organizations that will be created in 2002—the Agence Nationale du Patrimoine Minier and the Agence Nationale du Controle des Mines. In December, it was reported that SONATRACH would no longer conduct negotiations for new exploration and production contracts for crude oil and natural gas properties (Africa Energy Intelligence, 2000; African Mining Intelligence, 2000; Mining Journal, 2000c; Mining Magazine, 2000).

The Office Nationale de Recherche Géologique et Minière (ORGM) and the U.S. Geological Survey agreed to pursue scientific and technological cooperation in the earth sciences.

Structure of the Mineral Industry

The Ministère de l'Energie et des Mines (M.E.M.) is involved in most mineral production. The Ministère de l'Industrie et de la Restructuration (M.I.R.) is responsible for the construction material and mineral product sectors, which included brick, cement, glass, lime, steel, and refined zinc operations. The Agence de Promotion, de Soutien et de Suivi des Investissements provides potential investors with information on local business opportunities.

Government organizations that are involved in the mineral sector include M.E.M.'s Service Géologique Algérien and the ORGM, which is responsible for geologic and mining research. The mineral production section of the M.E.M. includes the state fertilizer company, the national salt mining company, the state-owned gold development company, the state iron and phosphate rock miner, the national sand and aggregate company, the state-owned marble producer, and the state nonferrous mineral mining company. In addition to M.E.M.'s 6 national enterprises, about 689 small private companies and 640 local public enterprises are authorized to produce aggregates, clay, gypsum, marble, or salt.

M.E.M.'s hydrocarbon branch includes SONATRACH, the state-owned petroleum refining company, the national petroleum distribution company, and Sonelgaz. In 2000, about 21 foreign oil companies were operating in association with SONATRACH on 31 contracts.

National enterprises within the M.I.R. include the Groupe SIDER and Enterprise Nationale de Métallurgie et de Transformation des Métaux Non Ferreux (METANOF).

Commodity Review

Although many mineral deposits had been identified by the ORGM, they were located in remote areas that lacked infrastructure, were uneconomic, or the mining enterprise to which the deposits were assigned was unable to secure Government funding for development (Ministère de l'Energie et des Mines, [undated], Opportunités d'invéstissements—Mines, accessed August 14, 2001, at URL http://www.mem-algeria.org/opportunites/opport_mines.htm). In 2000, the Ministry of Energy & Mines offered 48 small mining operations to private investors via the Avis d'appel aux investissurs No. 002/2000—Programme de Mise en Valeur de la Petite et Moyenne Mine (Mining Journal, 2000b).

Metals

Gold.—ENOR owned the Amesmessa and the Tirek gold projects southwest of Tamanrasset in the Hoggar region of southern Algeria. In 1999, the South African Council for Mineral Technology (Mintek) began sampling the Tirek prospect as part of the 1998 mining technology cooperation agreement that the Government signed with South Africa; in late 2000, Mintek shipped a 200-metric-ton-per-day gold recovery plant to Tirek (Mintek Bulletin, 2000). Production was scheduled to begin in 2001. In 2000, ENOR undertook a feasibility study of the Amesmessa gold prospect. In November, ENOR solicited partners to operate the Amesmessa and the Tirek gold projects and to explore the adjacent 1,200 square kilometers for gold. ENOR's resource estimates were 4.96 million metric tons (Mt) at grade of 14.1 grams per ton (g/t) gold for Amesmessa and 1.17 Mt at an average grade of 17 g/t gold for Tirek (Enterprise d'Exploitation des Mines d'Or, 2001, Geological context—Amesmessa deposit and Tirek deposit, accessed August 10, 2001, at URL http://www.enor.com.dz/geo_en.htm).

Steel.—In 1999, during the reorganization of Enterprise Nationale de Sidérurgie, the El-Hadjar steelmaking operations at Annaba were spun off as Sté. Algérienne de Fabrication Sidérurgique (ALFASID). In 2000, ALFASID produced 841,957 metric tons (t) of liquid steel. Its mills produced 303,377 t of hot-rolled coil, 143,142 t of cold-rolled coil, 83,498 t of galvanized products, and 157,016 t of rounds and wire rod. ALFASID continued its modernization program in 2000 with the renovation of 21 of the 65 furnaces in coke oven battery No. 1 by awarding Voest-Alpine Industrieanlagenbau GmbH & Co. of Austria the contract to rehabilitate the hot-rolling mill and continued the World Bank's industrial pollution control project (Sté. Algérienne de Fabrication Sidérurgique, [undated], ALFASID-Fiche Technique, accessed August 8, 2001, at URL http://www.alfasid.com.dz/presentation/fiche-technique.htm).

Zinc.—Breakwater Resources Ltd. of Canada announced its intent to acquire 90% equity interest in the Oued Amizour zinc project (Metal Bulletin, 2000). Negotiations continued through yearend.

Industrial Minerals

Cement.—In 2000, Algerian cement production was dominated by the plants of the five subsidiary companies of the regional cement group L'Entreprise des Ciments et Dérivés de l'Est (ERCE), which had a total output of 4.2 Mt of cement. The renovation of the Mefta plant of L'Entreprise des Ciments et Dérivés du Centre Group (ERCC) allowed ERCC to produce about 1.7 Mt, the three subsidiaries of L'Entreprise Ciments et Dérivés de l'Ouest (ERCO) produced about 1.4 Mt, and L'Entreprise des Ciments et Dérivés d'Ech Group (ECDE) at Chlef produced about 1 Mt. Installed cement capacities for the regional groups were ERCE, 4.4 million metric tons per year (Mt/yr); ERCO, 2.7 Mt/yr; ERCC, 2.4 Mt/yr; and ECDE, 2 Mt/yr. Proposed projects under evaluation included the 500,000-metric-ton-per-year (t/yr) expansion of ERCE's Société des Ciments de Tebessa capacity, the 1-Mt/yr cement plant at Djelfa and the 1-Mt/yr plant at El-Kseur for the ERCC Group, and a 125,000-t/yr white cement plant for ERCO at Beni-Saf (Ministère de l'Industrie et de la Restructuration, [undated], Presentation de la Branche de Materiaux de Construction—Activite des enterprises et capacites and Projets de developement, accessed August 8, 2001, at URL http://www.mir-algeria.org/materiaux.htm; M. Stiti, El Watan, April 1, 2001, CIMENT/Production record—Mais probables tensions, Letter to the editor, accessed April 2, 2001, at URL http://www.elwatan.com/journal/html/2001/04/01/economie.htm).

In November 2000, Algerian Cement Co. terminated plans for a proposed cement plant in Bejaia Province after it was unable to acquire the required permits. In December, Algerian Cement (a subsidiary of Orascom Construction Industries of Egypt) began an evaluation of ERCC's proposed Djelfa cement plant.

Fertilizer.—Enterprise Nationale de Engrais et des Produits Phytosanitaires (ASMIDAL) produced ammonia and nitrogenous and phosphatic fertilizers at its Fertial plant in Annaba and at the Alzofert plant in Arzew. In 2000, nitrogenous fertilizer production was 231,000 t compared with 85,000 t in 1997. Phosphatic fertilizer production was 212,000 t in 2000 compared with 118,000 t in 1997. In joint venture with Fritz Werner Industrie-Ausrustungen GmbH of Germany and Transammonia, Inc., of the United States, ASMIDAL planned to add a 675,250-t/yr-capacity unit to the existing 660,000-t/yr-capacity ammonia plant at Arzew by 2003 (Stell, 2001, p. 76; Group Industriel au Service du Developpement Agricole, [undated], Capacites du groupe, accessed August 10, 2001, at URL http://www.asmidal-dz.com/capacites_ammoniac_filiale.htm).

Mineral Fuels

In 2000, the M.E.M. reported 11 hydrocarbon discoveries that included initial discoveries and new reservoirs in known fields. Announced SONATRACH discoveries included the Damrane-2 on block 237B, the Hassi Terfa North-1 oil discovery on block 427, and the two gas discoveries in the Reggane Basin, the Azrafil Sud Est-1 on block 351B and the Djebel Heirane Kahla Tablbala-1 on block 352B (Oil & Gas Journal, 2000a; Middle East Economic Digest, 2001a; Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures, October 22, 2000, Nouvelle decouverte d'huile au sud est de Hassi Messaoud, accessed August 15, 2001, at URL http://www.sonatrach-dsz.com/decouberte.htm; Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures, September 25, 2000, Nouvelle decouverte de gaz, accessed August 15, 2001, at URL http://www.sonatrach-dsz.com/reggane25.htm). ARCO Ghadames Inc. successfully cased the Semhari East-1 wildcat as an oil well on the Hassi bir Rekaiz permit.

A number of international oil companies entered into service contracts with SONATRACH. Amerada Hess Corp. (AHC) agreed to invest an estimated $554 million to redevelop three Algerian oilfields—El Agrab, the Gassi, and the Zotti. AHC also committed to the exploration of the Rhourde El Rouni contract. First Calgary Petroleums Ltd. signed a 15-year contract to explore on block 406A. The contract called for the drilling of two wells by November 2003. The joint venture of BHP Petroleum Pty. Ltd. (60%), Japan Ohanet Oil and Gas Co. Ltd. (30%), and PetroFac Resources (Ohanet) LLC (10%) signed a risk service contract with SONATRACH to develop natural gas resources in the Ohanet region. BHP Petroleum also proposed to develop the oil resources of the Rhourde Oulad Djemma area on blocks 401A and 402A.

BP Amoco p.l.c. and SONATRACH agreed to proceed with the development of the In Salah project, which included the Garat al-Bafinat, the In Salah, the Krechba, the Reg, and the Teguentour gas prospects. Organisation Ourhoud awarded JGC Corp. of Japan and the recently privatized Spanish engineering company INITEC the contract to develop the Ourhoud oil prospect. When developed, Ourhoud, which straddles blocks 404, 405, and 406, would become the second largest oilfield in Algeria after the Hassi Messaoud (Bob Lunn, Bob Daniels, Stephen Linnard, and Lynda Okbi, 2001, The Ourhoud Field—Berkine Basin—Algeria, accessed August 16, 2001, at URL http://aapg.confex.com/aapg/de2001/techprogram/paper_8916.htm).

In September, CEPSA and SONATRACH agreed to evaluate the feasibility of building a third export pipeline from Algeria. The proposed pipeline would cross the Mediterranean Sea directly to Spain. In December, Conoco Inc. and SONATRACH agreed to study the possible use of Algerian gas to power electricity-generating projects in Algeria, Spain, and Turkey.

Reserves

Hydrocarbon reserve estimates varied. As of January 2001, Algeria was reported to have the 7th largest reserves of natural gas and the 14th largest oil reserves in the world. Estimated proven reserves were reported to be 9,200 million barrels and natural gas reserves were estimated to be 4.5 trillion cubic meters (Oil & Gas Journal, 2000b). The M.E.M. estimated that the country's recoverable oil reserves were about 14,600 million barrels and recoverable gas reserves were about 3 trillion cubic meters (Middle East Economic Digest, 2001a, p. 22).

Barite reserves were reported to be 9.5 billion metric tons (Gt); iron ore reserves, 3.5 Gt; lead/zinc reserves, 1.6 Gt metal content; phosphate rock reserves, 1.6 Gt; salt reserves, 1.5 Gt; diatomite reserves, 6.6 Mt; celestite reserves, 6 Mt; mercury reserves, 37,000 t metal content; uranium reserves, 26,000 t U_3O_8; and gold reserves, 110 t metal content (Mining Journal, 1999; Office de la Recherche Géologique et Minière, [undated], Mining potential, accessed August 14, 2001, at URL http://www.orgm.com.dz/potential.htm).

Infrastructure

Sonelgaz had an installed electricity generating capacity of 5,922 megawatts (MW) (Richards, 2001). Thermal plants (diesel, natural gas, and oil fired) accounted for about 99.8% of the electricity generated. Sonelgaz proposed to add a 2,000-MW plant to the national grid.

Algeria's railroad system [totaling 4,060 kilometers (km) of track] and its road network [covering more than 90,000 km] mostly served the northern section of the country and supported long-established mining and other export-oriented industries.

More than 13,200 km of pipeline served the hydrocarbon industries within Algeria. Three crude oil pipeline ran north to Skikda, Bejaia, and Arzew from Hassi Messaoud in the southeast. The focus of the natural gas pipeline network was Hassi R'Mel, from which pipelines were connected to liquefaction facilities at Arzew and Skikda. Hassi R'Mel also was the gathering point for natural gas exports to southern Europe by means of the 24-billion-cubic-meter-per-year-capacity 2,340-km Enrico Mattei pipeline (which was formerly the Trans-Mediterranean, or Transmed, pipeline) that extended from Algeria northeastward through Tunisia and under the Mediterranean Sea to Sicily and the Italian mainland and the 8-billion-cubic-meter-per-year-capacity 1,845-km Pedro Duran Farell pipeline (which was formerly the Maghreb-Europe pipeline) that traversed Algeria northwestwards through Morocco and the Straits of Gibraltar to Spain.

Outlook

With its location close to Europe, the country's major customer for its minerals, and its known undeveloped and inferred hydrocarbon deposits and functional infrastructure, Algeria is expected to be of significant interest to international construction, engineering, financial, and oil companies. Algeria's base and precious metals and industrial mineral occurrences and potential could entice international mineral exploration and development organizations, and the Government's interest in reducing the mineral economy's dependence on oil and gas could add incentives to the nonfuel mineral sector; recurrent guerilla activity, especially by the Armed Islamic Group and the Salafist Group for Preaching and Combat, however, remains a significant deterrent to investors (Mining Journal, 2000a).

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TABLE 1
ALGERIA: PRODUCTION OF MIENRAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/ 4/		1996	1997	1998	1999	2000 p/
METALS						
Cadmium, refined e/		75	75	70 r/	70 r/	70
Iron and steel:						
Iron ore, gross weight	thousand tons	2,245	1,637	1,783	1,336	1,645
Metal:						
Pig iron e/	do.	800	700	700	500	400
Steel, crude	do.	620	427	400 e/	758 r/	842
Lead:						
Concentrate, Pb content		1,016	845	730	1,215	818
Metal, refined e/		8,600	8,000	7,000	7,000	7,000
Mercury	kilograms	367,800	447,034	223,965	240,327	215,625
Silver e/	do.	2,000	1,600	1,500	1,400	1,400
Zinc:						
Concentrate, Zn content		5,912	3,690	4,555	9,808	10,452
Metal, smelter output e/		30,000	29,300	31,000	34,000	34,000
INDUSTRIAL MINERALS						
Barite, crude		31,348	39,140	37,006	50,510	51,925
Cement, hydraulic		6,500	7,000	7,500	7,500 e/	8,300 e/
Clays:						
Bentonite		17,200	17,657	15,655	15,491	22,708
Fuller's earth		4,500 e/	3,960	3,942	2,489	3,431
Kaolin		25,000 e/	18,533	13,640	16,833	11,616
Diatomite		3,700 e/	2,332	2,133	2,563	2,500 e/
Feldspar e/		7,000	7,000	7,000	2,820 5/	707 5/
Gypsum e/ 6/	thousand tons	250	275	275	1,316 r/ 5/	1,341 5/
Helium, liquid e/	million cubic meters	15	15	16	16 5/	10
Lime, hydraulic e/		62,000	65,000	65,000	76,000 r/	96,000
Marble		700,000 e/	702,000	732,000	665,000 e/	700,000 e/
Nitrogen, N content of ammonia 7/		149,900	379,400	350,200	455,400 r/	430,700
Phosphate rock:						
Gross weight	thousand tons	1,051	1,063	1,155	1,096	877
P_2O_5 content e/	do.	320 5/	330	358	340	265
Salt, brine and sea salt		178,000 e/	137,317	172,025	163,748 5/	182,000
Strontium minerals, celestite, gross weight e/		-- r/	-- r/	-- r/	-- r/	--
Sulfur, elemental e/		23,000	23,000	23,000	25,000	25,000
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross	million cubic meters	143,100	125,012	125,971	128,783 r/	139,499
Dry 8/	do.	62,300	97,458	96,873	97,151 r/	100,092
Natural gas plant liquids	thousand 42-gallon barrels	53,000	69,000 r/	77,200 r/	85,411 r/	95,619
Petroleum:						
Crude including condensate	do.	453,300	466,105	454,750	457,158 r/	476,288
Refinery products:						
Liquefied petroleum gas	do.	6,000 r/ e/	6,200 r/ e/	6,100 r/ e/	6,191	6,322
Gasoline	do.	20,000	17,313	17,836	20,310 r/	17,964
Naphtha	do.	31,000	33,233	31,688	32,757 r/	32,124
Kerosene and jet fuel e/	do.	8,100	8,000	8,000	10,428 r/	12,458 5/
Distillate fuel oil	do.	50,000	48,661	46,245	48,132 r/	44,820
Lubricants	do.	850 e/	686	728	777 r/	770
Residual fuel oil	do.	36,800	37,002	33,753	37,842 r/	36,803
Other e/	do.	3,500	2,500	2,000	2,884 r/ 5/	3,044 5/
Total	do.	156,000 r/	154,000 r/	146,000 r/	159,321 r/	154,305

e/ Estimated. p/ Preliminary. r/ Revised. -- Zero.

1/ Table includes data available through August 9, 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ In addition to the commodities listed, secondary aluminum, coke, secondary lead, and secondary copper may be produced in small quantities, and crude construction materials are produced for local consumption, but output is not reported and available information is inadequate to make estimates of production levels.

4/ In addition to the commodities listed, about 700 metric tons per year of caustic soda had been estimated to be produced.

5/ Reported figure.

6/ Includes about 50,000 metric tons per year of plaster.

7/ Additional nitrogen was produced by Helios, the helium liquids production company. In 1999, Helios produced more than 68,000 42-gallon barrels of liquid nitrogen and 14 million cubic meters of gaseous nitrogen.

8/ Excludes gas used in reinjection, flaring, venting, transmission losses, and natural gas liquids extraction.

THE MINERAL INDUSTRY OF

ANGOLA

By George J. Coakley

The Republic of Angola had a population of about 11 million in a 1,246,700-square-kilometer (km^2) area, which includes Cabinda, a 100-kilometer (km)-wide and 150-km-deep coastal strip that is located between the Congo (Brazzaville) and Congo (Kinshasa). The mineral economy of Angola was dominated by petroleum with diamond being another important source of revenues. Cabinda was the source of 62% of Angola's oil production followed by Block 3 with 23% in 1999 (the last year for which data was available). According to International Monetary Fund, petroleum and diamond accounted for 61.4% and 8.7%, respectively, of the nominal gross domestic product, which was estimated to be $5.6 billion in 1999; petroleum and petroleum products and diamond accounted for 87.8% ($5 billion) and 1.2% ($629 million), respectively, of the value of exports in 1999 (International Monetary Fund, August 2000, Angola—Recent economic developments, IMF Staff Country Report 00/111, accessed July 2, 2001, at URL http://www.imf.org/external/pubs/ft/scr/2000/cr00111.pdf).

The highlight of the mineral industry in Angola for 2000 continued to be the success of offshore deepwater petroleum exploration programs. Protected from the onshore civil war actions, the major oil-production-sharing consortiums, which were led by BPAmoco plc, Chevron Corp., ExxonMobil Angola Ltd., and TotalFinaElf, reported 34 significant new deepwater oil discoveries between 1996 and May 2001; 10 were found during 2000 (table 2). Added to the nine fields discovered in 1998 and the four other major discoveries since 1996, these new fields have the potential to double Angolan oil production to 1.3 million barrels per day by 2002. Production declined by 3% in 2000 to 272 million barrels.

Government Policies and Programs

Mining and petroleum development are governed by several legal statutes, most of which have been updated since 1992. They include Foreign Investment Law No. 15/94 of October 23, 1994, which empowers the Foreign Investment Center to reject or approve new investment applications within 45 to 90 days on investments of up to $50 million. Investments of more than $50 million must be evaluated and forwarded to the Ministry of Planning and Economic Coordination within 40 days, and a negotiating commission, established within another 15 days. The Law on Geological and Mining Activities (Mining Law) No. 1/92 of January 17, 1992, which is administered by the Ministry of Geology and Mines, establishes the legal framework for prospecting, mining, processing, marketing, suspension or exhaustion, and reclamation of mineral resources, which include stockpiles and waste heaps from old mining. Mineral rights are vested in the State. The law eliminates the state monopoly on mineral rights and provides for granting prospecting licences and mining titles to state-owned, mixed, private, or joint mining companies. As of mid-1997, 44 prospecting licences and 138 mining titles had been granted under the Mining Law. The separate Law on Diamonds, which was promulgated on January 7, 1994, grants exclusive mineral rights for diamond to Empressa Nacional de Diamantes de Angola (Endiama), which was the state-owned diamond mining company.

The laws on privatization were established under law No. 10/94 of 1994. Under decree No. 4-B/96 of May 31, 1996, which established the rules for taxation for the mining industry, domestic and foreign investors are treated equally. Corporate taxation is set at 40% of the net profit. Royalty rates are set at 5% on precious stones and metals, 4% on semiprecious stones, 3% on metallic minerals, and 2% on other minerals. A surface tax of from $1.00 to $4.00 per square kilometer held is paid during exploration. Depreciation of fixed assets is allowed, and exploration costs can be written off during the first 3 years of the mining stage (Sambula, 1998). Petroleum exploration and development are administered under the Hydrocarbon Law of 1978, which made Sociedade Nacional de Combustiveis de Angola (Sonangol) the sole concessionaire for exploration and production. International oil companies operate in joint ventures or under production-sharing agreements with Sonangol.

Commodity Review

Diamond.—Despite the ongoing civil war and United Nations (U.N.) sanctions against illegally mined diamond, officially reported diamond production increased by 17% to 4.3 million carats in 2000 compared with 1999 output of 3.7 million carats of diamond. According to the April 2001 U.N. report, 69% of the diamond under Government control in 2000 came from nine official mines; 31% was attributed to artisanal miners. The value of production was reported to be $398.5 million for the official sector and $347.6 million for the unofficial sector. Diamond smuggling by the National Union for the Total Independence of Angola (UNITA) and other sources was estimated to have increased to $250 million in 2000. The U.N. estimated that the total value of diamond mining, which included production from UNITA-controlled mines, was a minimum of $1.1 billion. The report also concluded "that the increase in non-UNITA smuggling during 2000 meant that illicit Angolan diamonds are still reaching diamond markets regardless of the certificate of origin system and which makes the tracing of UNITA smuggling more problematic." The U.N. report explained the operations of the Angola Selling Corp. (ASCorp), which was a Government single-channel marketing system designed to regulate diamond buying; efforts to train and regulate the estimated 100,000 artisanal miners working in Angola; and operations of the Guichet Unico, which was established to investigate applicants for diamond credentials and to issue credentials and to provide insights into illicit diamond trading and smuggling operations (United Nations Security Council, April 18, 2001, Addendum to the final report of the monitoring mechanism on sanctions against UNITA, accessed

July 15, 2001, at URL http://www.un.org/Depts/dhl/docs/s2001363.pdf).

In its December 2000 final sanctions monitoring report, the United Nations gave additional details on UNITA mining and international diamond smuggling operations between 1980 and 2000 (United Nations Security Council, December 21, 2000, Final report of the monitoring mechanism on sanctions against UNITA, accessed July 15, 2001, at URL http://www.un.org/Depts/dpa/docs/Monitoring%20final.PDF).

Sociedade Miniera de Catoca Ltda. (SMC) remained the largest producer in 2000 with output of around 1.5 million carats from its Catoca kimberlite pipe, which is 35 km south of Saurimo. SMC was a joint venture of Endiama (32.8%), Russia's Almazy Rossii-Sakha Co. (32.8%), Brazil's Odebrecht Mining Services Inc. (18.4%), and Israel's Lev Leviev (16%). Diamond reserves in the Catoca kimberlite were estimated to be at least 40 million carats (Embassy of Angola, Washington, DC, April 1999, Mining sector developments—Catoca diamond production expected to grow despite war, O Pensador, accessed June 11, 1999, at URL http://www.angola.org/news/pensador/april99/economic.html).

Sociedade de Desenvolvimento Mineiro de Angola, S.A.R.L. (SDM) (a joint venture of Ashton Mining Ltd. of Australia, Endiama, and Odebrecht), was formed in 1995 to mine alluvial diamonds in the 85,600-km^2 Cuango River Valley concession, which is centered near the town of Luzamba in northeastern Angola. The first stage of development of the alluvial operations at the Tázua Mine and the final recovery plant at Luzamba, as well as an agreement to sell production to De Beers Diamond Trading Corporation, was completed in 1998. Despite ongoing security problems and related intermittent work suspensions during the past 2 years, SDM produced 210,000 carats of high-quality diamonds in 2000 and 185,000 carats in 1999. Bulk sampling of river terrace gravels near the Ganzo, the Ginge, and the Tázua River diversions was continuing (Mbendi Information Services, May 16, 2001, Angola—Mining—Diamond, accessed July 15, 2001, at URL http://mbendi.co.za/indy/ming/dmnd/af/an/p0005.htm).

The establishment of ASCorp as a single diamond-buying agent effectively blocked sales to De Beers, which was the traditional purchaser of most Angola diamonds. In response to international concerns regarding "conflict diamonds," De Beers announced earlier in 2000 that it would stop buying all diamond rough from Angola except for those purchased under its agreement with SDM. In an effort to reinstate its buying agreement with SDM, De Beers offered to forfeit part of a $50 million loan given to Endiama to build a diamond sorting facility in Luanda. The Government, however, said it would repay the De Beers loan (Mazal U'Bracha Magazine, December 20, 2000, Angola pays off De Beers, accessed July 2, 2001, at URL http://www.diamondsview.com/news_205_dec.htm).

Associacao Chitotolo [owned by Sociedade Miniera de Lumanhe (50%), ITM Mining Ltd. (35%), and Endiama (15%)] produced 194,000 carats of alluvial diamond in 2000 (Mbendi Information Services, May 16, 2001, Angola—Mining—Diamond, accessed July 15, 2001, at URL http://mbendi.co.za/indy/ming/dmnd/af/an/p0005.htm).

DiamondWorks Ltd. of Canada held a majority interest in the Luo and the Yetwene alluvial diamond projects. Following an armed attack on the Yetwene camp on November 8, 1998, operations were suspended. The company resumed operations in April 1999 and, when faced with financial and security problems, placed the Yetwene operation on a care and maintenance in November 1999 and throughout 2000. Diamond production for the 8-month period from April to November 1999 was 39,388 carats valued at $4.5 million. The company wrote down more than $23 million in assets in Angola for 1999. DiamondWorks' Luo property was able to produce for a 5-month period in 2000 before being placed on a care-and-maintenance basis in May 2000. Production at Luo was 18,999 carats compared with 46,028 carats in 1999. The value of production of Luo diamonds in 2000, net of applicable taxes and duties, was reported to be $4.3 million. At yearend 2000, DiamondWorks had an extension for mining rights to five kimberlite pipes, which included the large Camatcha Pipe, pending with the Government. The future of DiamondWorks was subject to a January 2000 financial restructuring agreement with Lyndhurst Ltd., which, if completed, would give Lyndhurst control of DiamondWorks (DiamondWorks Ltd., 2001).

During 2000, SouthernEra Resources Ltd. of Canada completed a feasibility study and restructured its position in the proposed Camafuca kimberlite joint venture. Ownership will be split among Welox Limited, (a member of the Leviev Group of Companies) (33%), SouthernEra (32%), Endiama (an affiliate of Endiama) (20%), and Sociedade Mineira do Lucapa Limitada (SML) (15%). Welox had agreed to provide up to $18 million of the financing for the first phase of the project. In January 2001, the joint-venture partners accepted SouthernEra's Phase I feasibility study and submitted its application for the mining permits required to begin construction, which will take around 9 months to complete following granting of permits. The feasibility study was based on total resources at Camafucha to a depth of 145 meters (m) estimated to be 209.5 million cubic meters containing 23.24 million carats of diamonds valued at $109 per carat. The initial 5-year-long Phase I project will remove 6.13 million cubic meters of dredged material containing an average grade of 0.18 carat per cubic meter valued at $117 per carat. Dredged material will move by a slurry pipeline to a land-based conventional dense media separation plant. Estimated capital cost of the dredge and processing plant was $16 million (SouthernEra Resources Ltd., January 10, 2001, Camafuca feasibility study accepted by SouthernEra's partners study predicts outstanding financial performance for diamond project, Press Release, accessed February 9, 2001, at URL http://www.southernera.com/News_Releases/nr010110.htm).

During 2000, a joint venture between De Beers Angola Prospecting Ltd., (a wholly owned subsidiary of De Beers Consolidated Mines Ltd.) and Endiama announced the discovery of 17 new kimberlites in its concession areas in the Lunda Norte and Lunda Sul Provinces. Drilling and quantitative sampling were ongoing at yearend 2000. Work on its Mavinga and Quela concessions was suspended owing to security considerations.

International Defense and Security Forces Resources NV (IDAS) of the Netherlands Antilles [a 50-50 joint venture between Endiama and American Mineral Fields, Inc. (AMF), of Canada], held the Cuango International area prospecting license and the Luremo mining license in the Cuango Valley. IDAS had only limited access to the UNITA-controlled areas during 2000; no official production was reported. In October, AMF wrote down the value of its deferred costs at its Angolan properties to $1.00. In December, following prolonged negotiations with the Government to resolve a boundary dispute that affected the Luremo area, AMF agreed to relinquish its old Cuango and Luremo license areas and to accept a new license that covered an area of 3,000 km^2 that roughly corresponds to its old Luremo license. The terms and official confirmation of the new license were still pending at yearend (American Mineral Fields, Inc., 2001, p. 5).

Petroleum and Natural Gas.—The first impact of recent deepwater discoveries on production should be seen in 2001 as the Girassol field in block 17 and the Kuito field in block 14 come into production at 200,000 barrels per day (bbl/d) and 100,000 bbl/d, respectively.

The Ministry of Petroleum reported two categories of petroleum reserves as of yearend 1999. Proven reserves already developed and ready for production were 3.16 billion barrels (Gbbl). Newly discovered reserves not yet developed were estimated to be 1.57 Gbbl of petroleum (International Monetary Fund, August 2000, Angola—Recent economic developments, accessed July 2, 2001, at URL http://www.imf.org/external/pubs/ft/scr/2000/ cr00111.pdf). A June assessment by industry analysts Douglas-Westwood of the United Kingdom indicated that West Africa has close to 17 Gbbl of oil equivalent in deepwater prospects primarily in Angola, Equatorial Guinea, and Nigeria. This includes two world-class fields—TotalFinaElf's Girassol oilfield in Angola and Shell Exploration and Production Ltd.'s Bonga oilfield in Nigeria. Capital investments to develop these resources will exceed $5 billion per year by 2004. In Angola alone, 25 deepwater fields were discovered between 1996 and mid-2000 with reserves estimated to be more than 8 Gbbl of oil equivalent, of which two-thirds is oil (OilOnline, August 14, 2000, Setting the west Africa scene, accessed December 20, 2000, at URL http://www.oilonline.com/news_spotlight_offshore_setting081400.html).

Chevron Corp. brought the Kuito field in block 14, which was the first of the deepwater (385-m deep) oilfields in Angola, into production in late 1999. Full capacity of the $400 million vessel *Kuito* floating production storage and offloading vessel (FPSO) of 100,000 bbl/d was reached in early 2000 (Oil Online, November 2, 1999, Kuito kicks off for Angola, accessed January 20, 2001, at URL http://www.oilonline.com/news_spotlight_offshore_kuito110299.html). Chevron held a 31% interest in block 14, in joint venture with Sonangol (20%); Agip Angola Exploracao BV (20%); TotalFinaElf (20%); and Petrogal Exploração (a subsidiary of Galp Energia of Portugal) (9%).

Girassol, which was the second deepwater (more than 1,100 m) oilfield in Angola, was developed by the consortium led by TotalFinaElf at a capital cost of $3 billion. The FPSO *Girassol* produced its first oil in late 2000; full capacity of 200,000 bbl/d was expected during 2001. Other partners in block 17 with TotalFinaElf (40%) included ExxonMobil (20%), BP Exploration (Angola) Ltd. (16.67%), Den Norske State Oljeselskap a.s. (13.33%), and Norsk Hydro ASA (10%) (Bouygues Offshore, [undated], Girassol FPSO, accessed January 20, 2001, at URL http://www.bouygues-offshore.com/company/notre_offre/fiches/girassol.htm).

The third deepwater project in Angola was the FPSO *Kizomba-A* that was being built by an ExxonMobil Corp. consortium in block 15. ExxonMobil reported recoverable hydrocarbon potential in excess of 3 Gbbl of oil equivalent in block 15. Planning for multiple developments was underway with the first due to come on-stream in 2004 (ExxonMobil Corporation, November 30, 2000, ExxonMobil affiliate announces deepwater discovery on block 17, offshore Angola, Press Release, accessed December 15, 2000, at URL http://www.exxon.mobil.com/em_newsrelease/). A capital cost of $3.1 billion will be required for the FPSO *Kizomba-A* and development of the 1 Gbbl of petroleum reserves contained in the Chocahlo and the Hunga fields in block 15. The project will produce 250,000 bbl/d of oil by 2004. A similar *Kizomba-B* project will follow to develop 1 Gbbl of reserves in the Dikanza and the Kisanje fields in block 15. Esso Exploration Angola Limited (Esso Angola) (a subsidiary of ExxonMobil) was the operator with a 40% working interest. Other coventurers included BP Exploration (Angola) Ltd. (26.67%), Agip Exploration B.V. (20%), and Statoil (13.33%) (OilOnline, August 14, 2000, Next mega-projects set for takeoff, accessed December 20, 2000, at URL http://www.oilonline.com/news_spotlight_offshore_westafrica081400.html). The large capital costs involved in the development of recent discoveries in Angola and Nigeria will likely lead to development being done in sequence rather than in parallel.

Outlook

Although offshore petroleum development and exports will dominate the economy of Angola for years to come and will provide a major impetus to rebuilding the war-torn economy and infrastructure, mineral development, especially of diamond, will play a significant secondary role and will stimulate further economic growth on the local and regional levels. Areas in Angola with geologic environments known to be favorable to economic mineralization, such as iron ore, nickel, and platinum-group metals, have been off-limits to exploration during the prolonged civil war. The return of foreign investment and the application of modern exploration concepts and technology were required to stimulate additional opportunities for mineral discoveries in Angola. The attraction of needed new mineral investment, however, will be contingent on the end of the civil war and the stabilization of the political environment.

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Sambula, A.C., 1998, Investing in mineral development in Angola: Global Mining Investment Opportunities Symposium, Montreal, Quebec, May 3-7, 1998, Presentation, 13 p.

Major Source of Information

Ministry of Geology and Mines
P.O. Box 1260
Luanda, Angola
Telephone: (244-2) 326-724
Fax: (244-2) 321-655 or 322-569

TABLE 1
ANGOLA: PRODUCTION OF MINERAL COMMODITIES 1/

Commodity		1996	1997	1998	1999	2000
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand metric tons	270	301 2/	350 2/	350	350
Diamond 3/ 4/	thousand carats	2,500 2/	1,234 2/	2,764 2/	3,732 2/	4,349 2/
Granite	thousand cubic meters	1,500	1,500	1,500	1,500	1,500
Marble	do.	100	100	100	100	100
Salt	metric tons	30,000	30,000	30,000	30,000	30,000
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross 6/	million cubic meters	5,804	5,804	5,804 2/	5,800	5,800
Dry	do.	566	566	566 2/	560	560
Petroleum:						
Crude	thousand 42-gallon barrels	259,150 2/	262,800 2/	268,275 2/	279,590	272,290 2/
Refinery products e/ 5/	do.	11,000	11,700	13,180 2/	14,000	14,000
Liquified petroleum gas	do.	1,616	1,643	1,292	1,292	1,300

e/ Estimated.

1/ Includes data available through June 2001.

2/ Reported figure.

3/ Did not include smuggled production.

4/ Production was approximately 90% gem and 10% industrial grade.

5/ Included asphalt and bitumen.

6/ Angola has no natural gas distribution system. Most gas was vented and flared.

TABLE 2
ANGOLA: OIL AND GAS DISCOVERIES AND PROPOSED INVESTMENT FROM 1996 TO 2006

Company	Development	Commodity	Capacity 1/	Investment (million dollars) 1/	Startup date 1/	Comments, reserves etc.
Texaco	Luanda liquefied natural gas plant	Natural gas	5 billion cubic meters per year	$2,500	2005	Gas processing plant.
Sonangol/ExxonMobil	Lobito refinery	Petroleum, refined	200,000 barrels per day	2,000		Under consideration.
Chevron Corp. (31%) PSA	Block 14 - Kuito	Petroleum	100,000 barrels per day	400	2001	Discovered 1997.
Do.	Block 14 - Benguela	do.				Discovered January 1998.
Do.	Block 14 - Landana	do.				Discovered October 1998.
Do.	Block 14 - Belize	do.				Discovered 1998.
Do.	Block 14 - Tombocco	do.				Discovered October 2000.
Do.	Block 14 - Lobito-1X	do.				Do.
Chevron summary		do.		6,000	2000-06	
ExxonMobil Angola (40%) PSA	Block 15 - Kissanje	do.				Discovered 1998.
Do.	Block 15 - Marimba	do.				Do.
Do.	Block 15 - Hungo	do.				Do.
Do.	Block 15 - Dikanza	do.				Do.
Do.	Block 15 - Chocalho	do.				Discovered July 1999.
Do.	Block 15 - Xicomba	do.				Discovered September 1999.
Do.	Block 15 - Mondo	do.				Discovered June 2000.
Do.	Block 15 - Saxi-1	do.				Discovered August 2000.
Do.	Block 15 - Batuque-1	do.				Discovered November 2000.
Do.	Block 15 - Kizomba-A FPSO	do.	250,000 barrels per day	3,100	2004	Develops Hunga and Chocalho fields, 1-billion-barrel reserves.
Do.	Block 15 - Kizomba-B FPSO	do.				Develops Kissanje and Dikanza fields, 1-billion-barrel reserves.
Do.	Block 15 - Mblumbumba-1	do.				Discovered April 2001.
Do.	Block 15 - Vicango-1	do.				Discovered May 2001.
Do.	Block 15 - Mavacola-1	do.				Do.
ExxonMobil summary				NA		3 billion barrels oil equivalent recoverable in block 15.
TotalFinaElf (35%) PSA	Block 17 - Girassol	do.	200,000 barrels per day	3,000	2001	Discovered 1996.
Do.	Block 17 - Dalia	do.			2004	Discovered 1997.
Do.	Block 17 - Rosa	do.				Discovered 1998.
Do.	Block 17 - Liro	do.		3,000	2002+	Do.
Do.	Block 17 - Tulipa	do.				Discovered June 1999.
Do.	Block 17 - Orquidea	do.				Discovered September 1999.
Do.	Block 17 - Cravo	do.				Discovered October 1999.
Do.	Block 17 - Camelia	do.				Discovered December 1999.
Do.	Block 17 - Jasmine	do.				Discovered 2000.
Do.	Block 17 - Perpetua 1	do.				Do.
TotalFinaElf summary				NA		
BPAmoco (50%)/Shell (50%) PSA	Block 18 - Platina	do.				Discovered 1999.
Do.	Block 18 - Plutonio	do.				Do.
Do.	Block 18 - Galio	do.				Discovered 2000.
Do.	Block 18 - Paladio	do.				Do.
Do.	Block 18 - Cromio	do.				Discovered October 2000.
Do.	Block 18 - Cobalto	do.				Discovered December 2000.
BPAmoco summary				NA		
Total				20,000		

NA Not available. FSPO Floating production storage and offloading vessel.

1/ Blank column indicates no information was available.

THE MINERAL INDUSTRIES OF

BENIN, CAMEROON, CAPE VERDE, THE CENTRAL AFRICAN REPUBLIC, GABON, SÃO TOMÉ E PRÍNCIPE, AND TOGO

By Philip A. Szczesniak

BENIN

The production of mineral commodities represented a minor part of the economy of Benin. The economy was largely dependent on agriculture, cotton production, and regional trade; these sectors accounted for more than 80% of the country's gross domestic product (GDP), which was estimated on the basis of purchasing power parity to be about $8.3 billion in 1999 (the last year for which data are available) (U.S. Central Intelligence Agency, 2000, Benin—Economy, World Factbook, 2000, accessed July 30, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/bn.html).

All mineral resources belong to the Government, which grants exclusive rights for exploration and development. Regulation of mineral extraction industries rests with the Ministère des Mines, de l'Energie, et de l'Hydraulique. Act No. 83-003 of May 1983 was the Benin Mining Code, Decree 89-296 implemented the Code's regulations, and Act No. 83-004 addressed fiscal policy that affected mineral development. Law No. 98-030 of February 1999 and the Beninese Agency for the Environment addressed national environmental responsibilities. The Office Béninois de Recherches Géologiques et Minières was responsible for mineral development administration duties.

The mineral sector included mining of construction materials and gold and manufacturing of cement production. Formal gold exploration was concentrated in the Natitingou-Perma and the Djougou/Alédjo-Koura areas of the Atacora gold zone in northwestern Benin. Benin's Société des Ciments d'Onigbolo and the clinker-grinders Cimentierie du Bénin S.A. and Société des Ciments du Bénin had a capacity of about 875,000 metric tons per year (t/yr); this was nominally sufficient to fulfill domestic demand that was estimated at just more than 500,000 t/yr (International Cement Review, 2000).

In the petroleum sector, Zetah Oil Co. of Benin signed a 25-year production contract for the Sèmè field. This field had been closed by the Government in 1998 owing to environmental concerns (World Oil, 2000). At the end of 1999, a new oil terminal with an oil capacity of 55,000 cubic meters was opened in the port of Cotonou. It was to serve Benin, Burkina Faso, Mali, and Niger. Importation, distribution, and marketing of fuel products was carried out by the national oil company, Société Nationale de Commercialization des Produits Petroliers (Mbendi Information Services, July 12, 2000, Benin—Oil and gas industry, accessed March 30, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/be/p0005.htm).

In a major example of west African regional cooperation and good economic planning, a plan was in place to use Nigerian natural gas that was being flared in 2000 to help solve the long-term energy needs of its neighboring states of Benin, Ghana, and Togo. By using Nigeria's more than 40 trillion cubic feet of natural gas reserves, a consortium that was led by Chevron Nigeria Ltd. was committed to building the West African Gas Pipeline by 2002. The $400 million project will involve the construction of an 800-kilometer (km) offshore gas pipeline from the Niger Delta to the west coast city of Effuasi, Ghana. The pipeline will supply an initial amount of 120 million cubic feet per day of gas to existing and planned powerplants in Benin, Ghana, and Togo. Cooperators in the West African Gas Pipeline project included Nigerian National Petroleum Corp. (NNPC), Ghana National Petroleum Corporation (GNPC), Shell Petroleum Development Company, Société Togolese de Gaz, and SA Société Béninoise de Gaz (Chevron Nigeria Ltd., August 16, 1999, Chevron named project manager for west African gas pipeline project, Press Release, accessed November 9, 2001, at URL http://www.chevrontexaco.com/news/archive/chevron_press/1999/1999-08-16.asp; allAfrica.com, November 13, 2000, West African gas pipeline co-operating for energy security, accessed January 20, 2001, at URL http://allafrica.com/stories/200011130108.html).

Surveys discovered resources of more than 500 million metric tons (Mt) of iron ore that composes from 46% to 52% iron in Loumbou-Loumbou and Madekali in the district of Borgou. Phosphates have been found in an area of several kilometers in Mekrou (Mines '98, 1998, Benin—Geology and mineral deposits, Country Profile, accessed April 16, 2001, at URL http://www.mines98.com/country/bj/3.htm).

Electricity in Benin was provided by the state-owned Société d'Eau et d'Electricite (SBEE). With financial help from the World Bank and the Agence Française de Développement, SBEE launched several programs—a $30 million interconnection of the North Togo-North Benin networks designed to link up the towns of Dara in Togo and Parakou in Benin, a $21 million interconnection of the Nigerian Energy Power Authority's network designed to link up Porto Novo and Nigeria via the city of Ikeja, and a dam at Arjarala with a 900-megawatt hydroelectric power station at an estimated cost of $150 million (Africa Energy & Mining, 2000a).

To attract future investment in the mining sector, the Government continued to seek ways to revise and improve its mining laws. The development of the hydroelectric power station was seen as a key factor in the future potential development of the Loumbou-Loumbou and Madekali iron ore deposits and the Mekrou phosphate deposits.

CAMEROON

In 2000, crude oil production, which was the most significant segment of the mineral industry of Cameroon, accounted for nearly 50% ($989 million) of the country's total exports of $2.1 billion (World Bank, October 2, 2001, Cameroon at a glance, accessed November 9, 2001, at URL http://www.worldbank.org/data/countrydata/countrydata.html). Cameroon's GDP in 1999 was estimated to be $31.5 billion based on purchasing power parity; agriculture, which was the leading sector, accounted for 42% of the GDP. Cameroon had a population of more than 15 million people (U.S. Central Intelligence Agency, 2000, Cameroon—Economy, World Factbook 2000, accessed July 30, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/cm.html). Cameroon's energy and mineral resources included bauxite, diamonds, gold, limestone, marble, and petroleum.

The Ministère de Mines, d'l'Eau et de l'Energie was responsible for the administration of the mining sector. The state-owned Société Nationale des Hydrocarbures was involved in hydrocarbon production, and the state-owned Société Nationale de Raffinage managed the crude oil refinery (Mbendi Information Services, July 12, 2000, Cameroon—Oil and gas industry, accessed July 30, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/ca/p0005.htm).

The aluminum smelter at Edéa was owned and operated by Compagnie Camérounaise de l'Aluminium (Alucam) [a joint venture of Pechiney of France (58%) and the Government (42%)]. Alucam's alumina was imported from Guinea (Mbendi Information Services, November 15, 2000, Cameroon—Mining, accessed July 30, 2001, at URL http://www.mbendi.co.za/indy/ming/af/ca/p0005.htm).

The region where most of the gold has been discovered is in the eastern part of the country along the borders of the Central African Republic and Chad. The primary gold deposit of Mborguène is located 30 km northeast of Bétaré-Oya. The Government estimated that each year about 15,000 people engage in small-scale artisanal mining of gold. Minor amounts of diamond are also produced each year by small-scale artisanal operations (Mines '98, 1998, Cameroon—Geology and mineral deposits, Country Profile, accessed August 16, 2001, at URL http://www.mines98.com/country/cm/3.htm; Mbendi Information Services, November 15, 2000, Cameroon—Mining, accessed July 30, 2001, at URL http://www.mbendi.co.za/indy/ming/af/ca/p0005.htm).

The main petroleum operators in Cameroon were Elf Serepca, which was a subsidiary of TotalFinaElf of France, Pecten Cameroon Co. (a subsidiary of Shell Exploration and Production Co. of the United Kingdom), and Perenco plc of the United Kingdom. In September, Fusion Oil and Gas plc of the United Kingdom was awarded an exploration permit on Cameroon's deepwater MLHP-1 and MLHP-2 blocks in the Douala/Kribi-Campo basin (Africa Energy & Mining, 2000b).

CAPE VERDE

Mining's contribution to the economy of Cape Verde, which is an archipelago of 10 islands and 8 islets about 600 km off the western coast of Africa, was minimal. In 1999 (the last year for which data were available), the GDP was estimated to be $618 million based on purchasing power parity (U.S. Central Intelligence Agency, 2000, Cape Verde—Economy, World Factbook 2000, accessed July 30, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/cv.html).

Most of the nation's mineral requirements were imported. Salt was produced on the island of Sal, and volcanic rock, primarily pozzolana, was produced on Santo Antao. There also was intermittent production of clay on Boa Vista, Sal, and Sao Vicente; gypsum on Maio; and limestone on Boa Vista, Sal, and Santo Antao. For environmental reasons, the Government strongly discouraged mining beach sand for construction material.

The oil and gas industry was regulated by the Direcao Geral da Energia. The 40,000 t/yr of refined petroleum products that was consumed was imported either from Portugal or other African countries. Distribution and marketing of fuels was carried out by state-owned Empresa Nacional de Combustiveís, s.a.r.l., and Shell Cabo Verde s.a.r.l. No oil or gas was produced domestically; in fact, no oil or gas reserves were known (Mbendi Information Services, August 3, 2000, Cape Verde—Oil and gas industry, accessed March 21, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/cv/p0005.htm).

Economic reforms on the part of the Government aim to develop the private sector, to attract foreign investment, and to diversify the economy. Commerce, transport, and public services will continue to be major components of an economy, which is dependent on foreign aid.

CENTRAL AFRICAN REPUBLIC

In 2000, the mining sector, which was dominated by the production of diamond, accounted for about 4% of the GDP. Agriculture accounted for more than 50% of the country's GDP, estimated to be $5.8 billion based on 1999 purchasing power parity data (U.S. Central Intelligence Agency, 2000, Central African Republic—Economy, World Factbook 2000, accessed July 30, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/ct.html). The Central African Republic is a landlocked agrarian nation with a resident population of about 3.6 million in 2000.

After several years of recommending changes to the Government's mining laws, the World Bank took an active role in helping draft new code by sending experts to the Central African Republic as part of a $20 million loan package. World Bank and International Monetary Fund officials hoped for the acceptance of new legislation that bars the Government administration from involving itself directly in mining ventures; authorizing the sale of oil and gas licenses by auction to conform to the Treaty for Harmonization of African Business Laws, which was signed in 1993; and using international prices as benchmarks (Africa Energy & Mining, 2000c).

Gold was recovered by artisanal miners primarily from the Bandas and the Bogoin-Boali greenstone belts in the western part of the country. The local subsidiary of Axmin Ltd. of the United Kingdom, in joint venture with Asquith Resources, Inc. of Canada, drilled and explored the Roandji gold prospect (Asquith Resources, Inc., October 31, 2000, Axmin initiates follow-up program on the Roandji gold project, accessed November 1, 2000, at URL http://www2.cdn-news.com/scripts/ccn-release.pl?2000/10/31/1031061n.html).

Vaaldiam Resources Ltd. of Canada signed an agreement with United Reef Ltd. of Canada and Trans Hex International Ltd. of Canada to acquire an 80% interest in the Boungou River diamond property. The property is located 80 km north of the town of Bria and contains the Aigbando, the Djourou, and the Trouapou-Boungou alluvial diamond deposits. Expectations were for the production of 30,000 carats per year of diamond (Vaaldiam Resources Ltd., March 2, 2001, Central African Republic, accessed April 2, 2001, at URL http://www.vaaldiam.com/central-africa.html). Other companies holding diamond interests in Central African Republic were Central African Mining Co. s.a.r.l., J.A.B. International, Inc., of the United States, and Minedia s.a.r.l. (a joint venture of Ateba Mines, Inc., of Canada and local companies).

Other mineral occurrences in the Central African Republic included clay, copper, graphite, ilmenite, iron ore, lignite, limestone, manganese, monazite, rutile, tin, and uranium (Mines '98, 1998, Central African Republic, Country Profile, accessed November 9, 2001, at URL http://www.mines98.com/country/cf/3.htm). The lack of adequate transportation and industrial infrastructure hindered the development of the nation's mineral industry. Little of the country's 400,000-square-kilometer (km^2) Precambrian terrane has been explored by using modern exploration techniques (Knopf, 1999).

GABON

The equatorial African nation of Gabon has an area of 257,670 km^2 and supported a population of about 1.2 million in 2000. The GDP was $7.9 billion based on 1999 purchasing power parity data. The mineral industry was dominated by crude petroleum production, which accounted for 75% of the country's $2.4 billion in exports. Manganese was also a major mineral export (U.S. Central Intelligence Agency, 2000, Gabon—Economy, World Factbook 2000, accessed July 30, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/gb.html). Resources of columbium (niobium), gold, iron ore, and phosphate were known. Ownership of oil and gas and all mineral rights were vested in the Government.

In 1999, Cliff Mining plc of the United Kingdom acquired a 35% interest in Niobium Resources plc of the United Kingdom, which owned the Mabounié carbonatite complex near Lambaréné in the west-central part of the country. Cluff Mining plc reported an indicated resource of 21.6 Mt at a grade of 1.6% columbium (niobium) oxide that contains 345,600 metric tons of columbium (niobium) metal. This mineral resource was the basis for a feasibility study to be completed by 2001 examining the potential to produce 6,000 t/yr of ferroniobium (ferrocolumbium) (Cluff Mining plc, February 7, 2001, Gabon—Mabounie, accessed February 10, 2001, at URL http://www.cluff-mining.com/gabon.htm).

Eramet Manganese, which was 61% owned by the Eramet Group of France, operated the Compagnie Miniere de l'Ogooue S.A. (Comilog) Moanda manganese mine near Franceville. In 2000, manganese production declined to 1.74 Mt. The Moanda Mine had a capacity of 2.5 million metric tons per year with an estimated 100 years of resources (Eramet Group, March 29, 2001, Annual report 2000, accessed July 31, 2001, at URL http://www.eramet.fr/anglais/download/Annual_Report_Global.pdf).

Comilog's $70 million manganese ore enrichment and sintering plant in Gabon was inaugurated on December 30, 2000. The plant, which is located at Moanda, will have a production capacity of 600,000 t/yr of sintered manganese ore. The new plant will extend the life of the mine by allowing the processing of manganese fines and will provide a direct feed to Eramet's ferroalloy plants (Eramet Group, January 1, 2001, Start-up of the Moanda Industrial Complex in Gabon, accessed July 31, 2001, at URL http://www.eramet.fr/anglais/actionnaires_contenul.asp?ID=111).

In 2000, proven reserves of petroleum were estimated to be 2.5 billion barrels (Gbbl) which were nearly double the 1996 figure of 1.3 Gbbl. Production was 325,000 barrels per day (bbl/d), which was slightly below a level of 350,000 bbl/d established and maintained by the Government to ensure a consistent amount of production until new discoveries could be brought into production. The largest oilfield was the Rabi-Kounga Oilfield operated by Shell Oil; estimated reserves were 440,000 million barrels, and production was 150,000 bbl/d. About 20 companies have oil interests in Gabon (Mbendi Information Services, July 12, 2000, Gabon—Oil and gas industry, accessed April 2, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/ga/p0005.htm).

The outlook for the future of minerals development in Gabon is modest and contingent on future market conditions and exploration successes. The economy is likely to be dominated by the petroleum sector for the foreseeable future with the focus of new exploration on deepwater basins. The potential for new developments in columbium (niobium), gold, manganese, and possibly phosphate suggests a continued role for mining in the economy. The lack of adequate infrastructure in many areas of the country inhibits new grassroots exploration and remains a major constraint on development of the well-defined iron ore deposit at Belinga.

SÃO TOMÉ E PRÍNCIPE

The archipelago of São Tomé e Príncipe is located approximately 275 km west of Gabon and southwest of Equatorial Guinea and Cameroon in west Africa. In 1999 (the last year for which data were available), the GDP was estimated to be $169 million based on purchasing power parity (U.S. Central Intelligence Agency, 2000, São Tomé e Príncipe—Economy, World Factbook 2000, accessed July 30, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/tp.html). The São Toméan economy was dominated by agriculture; the mineral industry was not significant.

The oil and gas industry in São Tomé e Príncipe is regulated by the Ministry of Industry, Construction, and Housing. Refined petroleum products, as well as most manufactured goods and food, were imported from neighboring countries. In early 2001, Government officials announced an agreement with Nigerian officials regarding disputed offshore areas in the São Toméan part of the Gulf of Guinea; according to the signed treaties, Nigeria and São Tomé will obtain 60% and 40%, respectively, of the revenues from oil exploration in these areas (Africa Energy Intelligence, 2000; afrol.com information services, March 24, 2001, São Tomé reaches agreement on oil exploration with Nigeria, accessed August 1, 2001, at URL http://www.afrol.com/NEWS2001/stp001_oil_nigeria.htm).

TOGO

In 2000, mining played a minor role in Togo's economy. In 1999 (the last year for which data are available), the GDP was estimated to be $8.6 billion based on purchasing power parity; agriculture, which was the leading sector, accounted for 42% of the GDP (U.S. Central Intelligence Agency, 2000, Togo—Economy, World Factbook 2000, accessed July 30, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/to.html).

The Government pursued the privatization of its phosphate mines, which were operated by the Office Togolais des Phosphates; no serious offers, however, were made. Total production of phosphate continued to steadily decline in 2000; it dropped to 1.4 Mt after reaching a high of 2.7 Mt in 1996 (Africa Mining Intelligence, 2001).

As a condition for financial backing of its energy sector by the World Bank, the Togoese Government succeeded in the privatization of Compagnie d'Energie Electrique du Togo to Elyo/Hydro Quebec International of Canada. Part of the agreed upon 20-year contract was the establishment of a new company named Togo Electricite of which Elyo/Hydro Quebec International would be the main shareholder. Togo Electricite was expected to invest 40 million euros during a 5-year period to rehabilitate and develop the production and distribution infrastructure (Africa Energy & Mining, 2000d).

Togo's mineral industry included the mining of limestone and phosphate rock and the manufacturing of cement and clinker for the export market. There was some artisanal recovery of diamond and gold. Other mineral occurrences, which included attapulgite, barite, bauxite, bentonite, brick clay, dolomite, garnet, gypsum, iron ore, kaolin, kyanite, limestone, manganese, marble, monazite, peat, rutile, silica sand, and dimension stone, were known, and the Government considered many of the occurrences to be potential small-scale operations (Ministry of Mines, Energy, and Water Resources, 1995, p. 24-27, 29-34, 36-37, 39-50, 52, and 54-55).

Using Nigeria's more than 40 trillion cubic feet of natural gas reserves, a consortium (led by Chevron Nigeria Ltd.) committed to build the West African Gas Pipeline by 2002. An 800-km offshore gas pipeline will be constructed from the Niger Delta to the west coast city of Effuasi, Ghana, and supply an initial amount of 120 million cubic feet per day of gas to existing and planned powerplants in Benin, Ghana, and Togo (Chevron Nigeria Ltd., August 16, 1999, Chevron named project manager for west African gas pipeline project, accessed November 9, 2001, at URL http://www.chevrontexaco.com/news/archive/chevron_press/1999/1999-08-16.asp; allAfrica.com, November 13, 2000, West African gas pipeline co-operating for energy security, accessed January 20, 2001, at URL http://allafrica.com/stories/200011130108.html).

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TABLE 1
BENIN, CAMEROON, THE CENTRAL AFRICAN REPUBLIC, GABON, AND TOGO: ESTIMATES PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000
BENIN						
Cement, hydraulic		360,000	450,000	520,000	450,000	450,000
Gold	kilograms	300	500	500	500	500
Petroleum, crude	thousand 42-gallon barrels	600	400	200	--	--
CAMEROON						
Aluminum metal, primary		82,000	91,000 r/	82,000 r/	92,000 r/	95,000
Cement, hydraulic		600,000	620,000	450,000	500,000 r/	500,000
Gold, mine output, Au content	kilograms	1,000	1,000	1,000	1,000	1,000
Petroleum:						
Crude	thousand 42-gallon barrels	33,945 4/	43,000	45,000	47,000	47,000
Refinery products	do.	9,200	9,200	10,000	10,000	10,000
Pozzolana		80,000	100,000	105,000	90,000	90,000
Sand, silica		12,000	12,000	12,500	12,000	12,000
Stone:						
Limestone		50,000	50,000	50,000	50,000	50,000
Marble	thousand cubic meters	560	560	580	580	580
Tin, ore and concentrate:						
Gross weight	kilograms	-- r/	-- r/	-- r/	-- r/	--
Sn content	do.	-- r/	-- r/	-- r/	-- r/	--
CENTRAL AFRICAN REPUBLIC						
Diamond	carats	470,000	500,000	530,000	530,000 r/	530,000
Gold	kilograms	90	90	100	100	100
GABON						
Cement:						
Clinker		162,000	176,000	180,000	180,000 4/	180,000
Cement, hydraulic 5/		185,000	205,000	196,000 4/	200,000 r/	200,000
Diamond, gem and industrial	carats	500	500	500	500	500
Gas, natural, gross	million cubic meters	100	99	99	99	99
Gold, mine output, Au content 6/	kilograms	70	70	70	70	70
Manganese:						
Metallurgical-grade ore, gross weight (50% to 53% Mn)	thousand metric tons	1,933	1,860	2,044	1,908 r/	1,700
Pellets, battery- and chemical-grade, gross weight (82% to 85% MnO_2)	do.	50	44	48	44 r/	40
Petroleum:						
Crude	thousand 42-gallon barrels	134,000	134,000	132,000	124,500	124,500
Refinery products	do.	6,043	6,315 4/	6,200 4/	6,315	6,315
Uranium, content of concentrate		623	472 4/	862 4/	347 7/	-- 7/
TOGO 8/						
Cement 9/		413,000	421,000	565,000	560,000	560,000
Iron and steel, semimanufactures 10/		500	--	--	--	--
Phosphate rock, beneficiated product:						
Gross weight	thousand metric tons	2,731	2,631	2,253	1,700	1,400
P_2O_5 content	do.	980	950	810	600	350

r/ Revised. -- Zero.

1/ Includes data available through August 1, 2001.

2/ Estimated data are rounded to no more than three significant digits.

3/ In addition to the commodities listed, a variety of industrial minerals and construction materials (clays, gypsum, sand and gravel, and stone) are produced, but information is inadequate to make reliable estimates of output.

4/ Reported figure.

5/ Includes cement produced from imported clinker.

6/ Gold production figures do not include production smuggled out of the country, which, in recent years, was estimated to exceed 400 kilograms per year.

7/ Moanda uranium mine depleted and closed in 1999.

8/ Togo also presumably produced diamond and gold, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

9/ Produced from imported clinker.

10/ Iron rod production from semifinished metal.

THE MINERAL INDUSTRY OF

BOTSWANA

By George J. Coakley

The Republic of Botswana is a landlocked nation in southern Africa surrounded by Namibia to the west, South Africa to the east and south, and Zambia and Zimbabwe to the north; it covers an area of 600,379 square kilometers. In 2000, it supported a population of 1.65 million. For 1999 (the latest year for which data were available), the per capita gross domestic product (GDP) (based on 1999 purchasing power parity estimates) was $3,900. Botswana, which has been one of the most successful performing economies in the developing world, averaged more than 9% real economic growth from 1966 to 1997. The diamond sector, which continued to be the mainstay of the economy, accounted for about one-third of the GDP, 45% of Government revenues, and 75% of export earnings. Botswana was the world's largest producer of diamond, by value. Nickel, copper, and soda ash production also played significant though smaller roles in the national economy. The mining and quarrying sector accounted for 14,500 jobs, or about 6% of the total workforce, in 1999 (International Monetary Fund, November 1999, Botswana—Selected issues and statistical appendix, IMF Staff Country Report No. 99/132, accessed June 15, 2001, at URL http://www.imf.org/external/pubs/ft/scr/1999/cr99132.pdf).

Government Policies and Programs

The Ministry of Minerals, Energy and Water Affairs has responsibility for coordinating development and operational activities in the energy, minerals, and water sectors. Specific program responsibilities are carried out by Ministry departments, which include Mineral Promotion, Geological Survey, Mines and Water Affairs, and two parastatal organizations: Botswana Power Corp. and the Water Utilities Corp. Mining was governed by the new Mines and Minerals Act No. 17 of July 1999, which was designed to promote new foreign investment in exploration and mine development. The new act continued to vest all mineral rights in the State but introduced a new "retention license" that guarantees security of tenure from exploration to development but allows a company to retain its rights for a 3-year period, renewable once for no more than 3 years if then-current market conditions are not favorable to exploit the deposit. The act sets out guidelines for prospecting and mining licenses, environmental protection measures, royalties, and mining taxation. The Government retains an option to acquire up to a 15% interest in new ventures on commercial terms, thus abolishing its previous free equity participation (News Africa.com, 2001, Botswana mining—Botswana Mineral Act, accessed June 15, 2001, at URL http://www.newafrica.com/mining/laws/countries.asp?countryID=7). Oil and gas exploration and development is governed by the Petroleum (Exploration and Production) Act of May 1983. Investment in diamond mining is subject to a negotiated agreement with the Government. The Precious and Semi-precious Stones (Protection) Act of 1969 provides for the protection of the precious stones industry and regules dealings in precious stones and semiprecious stones.

Production and Trade

The value of mineral production in 2000 was approximately $2.42 billion, of which diamond accounted for $2.13 billion, or 88%; copper-nickel-cobalt for $243 million; and soda ash for $26 million. For the major commodities, the value of production was approximately equal to the value of mineral exports. Diamond production increased by 6% from that of 1999 because the new Orapa mine expansion came on-stream in May. Copper and nickel production were up slightly by 2%. Heavy rains and flooding of the brine evaporation pans during the year saw salt and soda ash production drop by around 20% each. Production statistics are listed in table 1. United Nations sanctions against so-called conflict diamonds from civil war zones in Angola, the Democratic Republic of the Congo, and Sierra Leone increased the market appeal of diamond from Botswana.

Structure of the Mineral Industry

The Government maintained an equity position in most of the major mining companies, but the industry was operated, for the most part, on a privately owned free-market basis. In a 50-50 joint partnership with De Beers Centenary AG, the Government owned Debswana Diamond Co. (Proprietary) Ltd., which was the country's largest mining company. Anglo American plc of the United Kingdom and the Government held equity positions in several other major mining companies; these included the nickel-copper-cobalt producers Bamangwato Concessions Ltd. (BCL) (Government 35%; Anglo American, 23%) and Tati Nickel Mining Co. (Pty.) Ltd. (Anglo American, 43.35%; LionOre Mining International Ltd. of Canada, 41.65%; and Government, 15%) and the soda ash company Botswana Ash (Pty.) Ltd. (Government, 50%; Anglo American, 21%). In June, Anglo sold its interest in Morupule Colliery (Proprietary) Ltd., which was the country's only coal mine, for $2.8 million to Debswana, which then had a 93% controlling interest in Morupule. In addition to these major operations, the mining industry consisted of a number of medium- and small-scale mines that produced agate, aggregates, brickmaking clay, gold, and dimension stone.

Commodity Review

Metals

Cobalt, Copper, and Nickel.—BCL owned the Phikwe, the Selebi, and the Selebi North cobalt-copper-nickel mines and a smelter at Selebi-Phikwe about 350 kilometers (km) northeast of the capital of Gaborone. In addition to treating its own ore, BCL toll-smelted concentrate and ore for Tati Nickel. In 2000, the BCL smelter produced 62,000 metric tons (t) of matte that contained 20,977 t of copper, 24,218 t of nickel, and 319 t of cobalt compared with 60,500 t of matte that contained 20,960 t of copper, 22,898 t of nickel, and 331 t of cobalt in 1999. Cobalt-copper-nickel matte was shipped to Norway and Zimbabwe for refining. Combined mine production for 2000 at BCL and Tati Nickel was 5.65 million metric tons (Mt) that averaged 0.68% copper and 0.61% nickel. Mine production at BCL was 3.4 Mt at a grade of 0.66% nickel and 0.76% copper. During 1999 and 2000, BCL developed a new tertiary subincline shaft at its No. 3 shaft.

Tati Nickel operated the Phoenix open pit nickel mine, the Selkirk underground mine, and a magnetic separator plant near Francistown. The company produced 6,483 t of nickel, 2,354 t of copper, and 38 t of cobalt in 2000 after the operation recovered from excessive rains in the first quarter. During 2000, the Phoenix Mine produced 21,324 t of concentrates at a grade of 5.8% nickel and 1.46% copper, and the Selkirk Mine delivered 58,100 t of ore at a grade of 2.6% nickel and 1.64% copper. The company also received byproduct credits for gold, palladium, platinum, and silver (LionOre Mining International Ltd., March 30, 2001, Nickel—Botswana—Tati Nickel, accessed June 12, 2001, at URL http://www.lionore.com/Nickel/Frameset.html).

Anglo American announced plans to invest $62.5 million in doubling refined nickel production at Tati to around 12,500 metric tons per year. The project will involve expansion of the open pit, installation of a 3.6-million-metric-ton-per-year (Mt/yr) wet concentrator, and construction of a 43-km water pipeline from the Shashe Dam to the Phoenix Mine. Subject to securing guarantees on financing and electrical power and water supplies, the project was scheduled for completion early in 2002 (Anglo American plc, March 16, 2000, Tati Nickel to double production, accessed April 2, 2000, at URL http://www.angloamerican.co.uk/news-detail.asp?news-item-number=63592).

Reserves and resources as of yearend 2000 were reported at both Botswana operations. BCL's mine life expectancy to 2011 was based on ore reserves pro rated from Anglo American's 23% share, which totaled 27 Mt at a grade of 0.86% copper and 0.84% nickel, plus additional measured and indicated resources estimated to be 33.5 Mt at a grade of 0.76% copper and 0.62% nickel. The remaining 16-year life expectancy at Tati Nickel's Phoenix Mine was based on ore reserves pro rated from Anglo American's 43% share, which totaled 46 Mt at a grade of 0.32% copper and 0.56% nickel (Anglo American plc, March 13, 2001, Reserves and resources—Annual report for 2000, accessed June 20, 2001, at URL http://www.angloamerican.co.uk/report2000/Report/ReservesResources.html).

In the second quarter of 2000, Gallery Gold Ltd. of Australia acquired the Tekwane Property from Falconbridge Ltd. of Canada. The property covers the eastern half of the intrusive body that hosts the operating Selkirk nickel mine.

Gold.— Gallery Gold continued gold exploration on its Mupane Prospect in the Tati greenstone belt of northeast Botswana. Analysis of 103 holes drilled through yearend 2000 identified an inferred mineral resources of 5.84 Mt of mineralization at a grade of 3 grams per ton equal to 17,300 kilograms (557,000 ounces). Exploration at Mupane will continue during 2001 (Gallery Gold Ltd., March 22, 2001, Mupane gold prospect—Initial resource estimate, accessed June 18, 2001, at http://www.gallerygold.com.au/announcements/MupaneResources21Mar01.htm). Trillion Consolidated Resources Ltd. of Canada held a number of gold prospecting licenses but was inactive during 2000.

Industrial Minerals

Diamond.—Debswana recovered diamond from the Jwaneng, the Letlhakane, and the Orapa Mines. Diamond production increased by 6% to more than 24.2 million carats compared with that of 1999. Production was sold through the De Beers Diamond Trading Company (formerly the Central Selling Organization). Debswana owned subsidiaries for diamond sorting and valuation (Botswana Diamond Valuing Co.) and for value-added cutting and polishing diamond (Teemane Manufacturing Co.). Teemane exported 8,195 polished carats in the form of 125,537 stones in 1999. Jwaneng, which was the richest diamond mine in Africa and is located 120 km west of Gaborone, treated 9.24 Mt of ore and recovered 11.52 million carats at an average value of $108 per carat in 2000. Total reserves and resources located in three main kimberlite pipes at Jwaneng were reported to be 287.6 Mt at a grade of 143.6 carats per hundred metric tons. The Letlhakane Mine, which is located 190 km west of Francistown, treated 3.51 Mt of ore and recovered 960,000 carats at an average value of $191 per carat. Total reserves and resources located in three main kimberlite pipes at Letlhakane were reported to be 62.6 Mt at a grade of 26 carats per hundred tons. The Orapa Mine, which is located 240 km west of Francistown, treated 14.68 Mt of ore and recovered 12.17 million carats at an average value of $47 per carat. Total reserves and resources located at Orapa were reported to be 652.9 Mt at a grade of 49 carats per hundred tons (De Beers Consolidated Mines Ltd., 2001, Debswana—Operations, accessed June 15, 2001, at URL http://www.debeersgroup.com/debswana/debsOperations.asp).

Debswana completed its $300 million expansion of the Orapa Mine during 2000. The 4-year construction project was designed to double Orapa's production to 12 million carats per year from 6 million by mining and treating an additional 8.9 Mt/yr of ore. The project included installation of a new diamond treatment plant, a new primary crusher, a completely automated recovery plant (CARP), and related infrastructure. The CARP is a high-security, 15-story building in which ore flows from top to bottom. Only x-ray technology is used to recover the diamonds; no human picking or sorting is done. The expansion will allow for production from the Orapa open pit for 30 years with the potential of extending the mine life by another 20 or 30 years by shifting to underground mining (Tassel, 2000).

A number of international mining companies held diamond licenses, for example, the joint venture of AfriOre (Botswana) (Pty.) Ltd. [a subsidiary of AfriOre (Mauritius) Ltd.] and Billiton plc of the United Kingdom, and Gope Exploration Co. [the joint venture of De Beers Prospecting Botswana (Pty.) Ltd. and the Botswana subsidiary of Falconbridge Ltd. of Canada].

Salt and Soda Ash.—After having recovered from the disastrous floods, financial liquidation, and restructuring of the late 1990s, Botash continued to operate its brine mining and treatment facility at Sua Pan, which is 173 km northwest of Francistown. Affected by heavy rains early in 2000, production of salt declined to 184,755 t from 233,069 in 1999, and that of soda ash, to 191,043 t from 233,643 t in 1999. Botash pumped salt brines from nearly 100 wells to nearby large evaporation ponds at a rate of about 2,400 cubic meters per hour. More than 300 metric tons per day of carbon dioxide recovered from an associated coal cogeneration plant was used in carbonation of the brines to produce the soda ash. Finished products were railed to Francistown for shipment to markets in South Africa, Zambia, and Zimbabwe.

In February 2001, the South Africa Competition Commission ruled in favor of Botash in a long standing trade dumping case against the America Natural Soda Ash Corp. (Ansac), which was a joint venture of a number of U.S. soda ash producers that were selling into the South Africa market. Botash claimed that Ansac was selling soda ash into South African markets below the price charged to U.S. consumers and that this contributed to the financial liquidation of its predecessor company in 1995. Ansac will appeal the ruling (Tim Cohen, Glassbytes, February 27, 2001, United States found to be contravening South Africa competition laws, accessed June 18, 2001, at URL http://glassbytes.com/022701africa.htm).

Mineral Fuels

Coal.—The Morupule Colliery, which was the only coal mine in the country, had an annual production capacity of about 1 Mt. Most of its output fed the nearby Botswana Power thermal powerplant at Morupule, which supplied more than 50% of Botswana's electricity requirements, or about 1,060 kilowatt hours of energy. Other customers included the nickel and soda ash companies. Coal is extracted underground from a 12-foot seam by using mechanized room-and-pillar mining, is sent to the surface on shuttle cars on an inclined ramp, and is then conveyored to the Morupule powerplant. Reserves in the Morupule field were estimated to be 8 billion metric tons of steam coal with 18% to 24% ash and a calorific value of 23 to 25 megajoules per kilogram (Ministry of Minerals, Energy and Water Affairs, December 1999, Mining investment opportunities in Botswana—Mineral promotion, accessed June 18, 2001, at URL http://www.gov.bw/government/ministry_of_minerals_energy_and_water_affairs.html#mineral_promotion).

Infrastructure

Transportation facilities were good on the eastern fringe of the country. In 1998, the 850-km Trans-Kalahari highway was opened from Gaborone, Botswana, to Gobabis, Namibia. Highways also connected landlocked Botswana with South Africa and Zimbabwe. A single-track railroad, which was operated by Botswana Railways, runs from north to south through the eastern part of the country and connects with the South African and the Zimbabwean rail systems.

Outlook

Revenues from diamond mining and cutting should continue to be the mainstay of the economy for the foreseeable future. The country's favorable geologic environment, mineral investment climate, political stability, and low tax rates should continue to make Botswana a target for foreign mineral investment. Incentives provided in the new Mining Law of 1999 were aimed at helping the Government diversify the national economy and reduce its reliance on the diamond industry.

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TABLE 1
BOTSWANA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1996	1997	1998	1999	2000
Coal, bituminous		763,240	776,920	928,100	945,316 r/	950,000 e/
Cobalt, smelter output, Co content of matte 3/ 4/		408	334	335 r/	331 r/	319
Copper:						
Mine output, Cu content of ore milled		25,275	22,840	25,043	37,604 r/	38,420
Smelter output, Cu content of matte 3/ 4/		20,980	19,820	22,124	20,960 r/	20,977
Diamond 5/	thousand carats	17,388	20,111	19,772	22,898 r/	24,218
Gemstones, semiprecious 6/	kilograms	35,000	54,000	38,000 r/ 3/	84,000 r/	80,000 e/
Gold 7/	do.	5	28	1	2 r/	4
Nickel:						
Mine output, Ni content of ore milled		21,910	19,860	21,700	33,733 r/	34,465
Smelter output, matte, gross weight 3/		58,910	50,570	56,732	60,500 r/	62,000
Smelter output, Ni content of matte 4/		22,095	20,157	22,851	22,898 r/	24,218
Salt 8/		93,886	184,530	214,700	233,069 r/	184,755
Sand, construction 9/	cubic meters	100,000	110,000	90,000 e/	90,000 e/	100,000 e/
Soda ash, natural		119,137	199,990	189,700 r/	233,643 r/	191,043
Stone, crushed	cubic meters	845,526	1,091,880	997,244	1,466,100 r/	1,050,700

e/ Estimated. r/ Revised.

1/ Table includes data available through June 2001.

2/ In addition to commodities listed, clay (for brick and tile) and silver were produced, but information was inadequate to estimate output.

3/ Smelter product was granulated nickel-copper-cobalt matte.

4/ Included some product from direct smelting ore; that is, ore not reported as milled.

5/ Assumed to contain about 70% gem and near gem.

6/ Principally agate. Reported as sales.

7/ Reported as bullion; historically included silver estimated to be about 2%.

8/ From natural soda ash production.

9/ Additional production of sand and gravel from small local operations was periodically reported, but information was inadequate to estimate output.

Source: U.S. Geological Survey Minerals Questionnaire for 1999-2000, prepared by Botswana Department of Mines

THE MINERAL INDUSTRIES OF

BURKINA FASO, MALI, MAURITANIA, AND NIGER

By Philip A. Szczesniak

BURKINA FASO

In 2000, the mineral sector played a minor role in Burkina Faso's economy, which was dominated by agriculture and services. The gross domestic product (GDP), which was based on purchasing power parity in 1999, was $12.4 billion. In 1999, exports were $255 million led by cotton, which accounted for more than one-half of total exports and gold. Burkina Faso's population as of July 2000 was estimated to be 11.9 million (U.S. Central Intelligence Agency, 2000, Burkina Faso—Economy, World Factbook 2000, accessed September 14, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/uv.html; World Bank, September 12, 2000, Burkina Faso at a glance, accessed September 14, 2001, via URL http://www.worldbank.org/data/countrydata/countrydata.html). Burkina Faso produced gold, manganese, marble, pumice, and salt.

The Government agency responsible for mining is the Ministère de l'Énergie et Mines. In 1997, the Government adopted a new mining code with two primary objectives—to standardize all the legal measures that are used to regulate the mining sector and to amend those parts of the previous legislation that had proved inadequate and hindered future mining development. Other provisions of the 1997 mining code are as follows: to prevent the state from holding sole ownership of a mining title, to ensure that an exploration permit confers the automatic right for the holder to apply for a mining permit for deposits discovered within the area concerned, to require a mining permit holder to begin production within 2 years of the permit being granted, and to retain a 10% free-carried state interest in the project (Mining Journal, 2000d).

The Poura gold mine closed in 1999 despite completion of a $11.6 million rehabilitation project in 1997 that had been financed by the European Union. The Mining Minister said that the mine had to be closed owing to low gold prices (Chamber of Mines of South Africa, September 2, 1999, Burkina Faso closes gold mine, Business Day (Johannesburg), accessed September 14, 2001, at URL http://www.bullion.org.za/bulza/newsotd/1999notd/020999.htm). The mine was owned by Sahelian Goldfields, Inc. of Canada and had a remaining resource of 450,000 metric tons (t) at a grade of more than 12 grams per metric ton (g/t) gold.

Numerous other mining companies had gold interests in Burkina Faso in 2000. Among them were Ashanti Goldfields Co. Ltd. of Ghana, Channel Resources Ltd. of Canada, Cluff Mining plc of the United Kingdom, Coronation International Mining Corp. of Canada, Delta Gold Ltd. of Australia, Echo Bay Mines Ltd. of the United States, High River Gold Mines Ltd. of Canada, Orezone Resources, Inc. of Canada, Placer Dome Inc. of Canada, Randgold Resources Ltd. of South Africa, Ranger Minerals Ltd. of Australia, Repadre Capital Corp. of Canada, Resolute Mining Ltd. of Australia, and Semafo Inc. of Canada. Artisanal workers produce around 1,000 kilograms per year (kg/yr) of gold (Mbendi Information Services, April 25, 2001, Burkina Faso—Mining—Gold mining, accessed June 8, 2001, at URL http://www.mbendi.co.za/indy/ming/gold/af/bf/p0005.htm).

In 1999, Billiton plc of the United Kingdom sold to Metorex Ltd. of South Africa its 90% holding in the Perkoa zinc deposit, which is located in western Burkina Faso; the Government of Burkina Faso owned the remaining 10%. Perkoa is a high-grade zinc ore deposit still in development with resources of 7 million metric tons (Mt) at a grade of 17.6% zinc at a cutoff grade of 10% zinc. Planned production levels are 60,000 metric tons per year (t/yr) of zinc with an estimated mine life of 15 years. In 2000, Metorex Ltd. was seeking investment in infrastructure needs, such as water supply, roads, and power; the deposit is located within 30 kilometers (km) of an already existing railway line (Metorex Ltd., December 14, 2000, Metorex poised to enhance delivery, press release, accessed February 6, 2001, at URL http://www.metorexgroup.com/pr7.htm).

MALI

Mali's mineral sector was dominated by gold mining, and in early 2001, the country became the third largest gold producer in Africa after South Africa and Ghana (Mbendi Information Services, July 31, 2001, Mali—Mining—Gold mining, accessed September 13, 2001, at URL http://www.mbendi.co.za/indy/ming/gold/af/ml/p0005.htm). Since 1997, Mali has attracted more than $850 million in new gold development investments and was expected to be producing around 50,000 kg/yr of gold by 2006. Mali's economy was dominated by agriculture in 2000, which accounted for about 47% of the GDP; the GDP based on purchasing power parity in 1999 was $8.5 billion. In 1999, exports, which were led by cotton, gold, and livestock, totaled $640 million. Mali's population as of July 2000 was estimated to be 10.7 million (U.S. Central Intelligence Agency, 2000, Mali—Economy, World Factbook 2000, accessed August 16, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/ml.html). Principal mining output in 2000 included diamond and gold. Mineral exploration interest was focused on diamond, gold, and oil.

The Government agency responsible for mining is the Direction Nationale de la Géologie et des Mines, which is part of the Ministère des Mines, de l'Énergie et de l'Hydraulique. In 1999, at the request of mining companies, the Government agreed to set up a regional mining office in Kayes in the western part of the country; mining officials noted that this would eliminate the need for officials of mining companies and the Government to travel up to 500 km between the capital Bamako in southern Mali and the primary mining region to carry out routine administrative operations. In addition, the Government revised its mining code by making changes to taxes and mining permits. The total taxes on sales by mining companies were reduced to 3% from 6%; the tax on proceeds from the transfer of shares in mining companies was reduced to 10% from 20%; and the tax on vehicle insurance for vehicles used on mining sites was eliminated. The length of tenure for medium-scale mining permits was extended from 2 to 3 years; and a 4-year permit was introduced for small-scale mining (Direction Nationale de la Géologie et des Mines, 2000; Mining Journal, 2000d).

In 2000, seven significant gold deposits were in either production or a development stage in Mali (table 2). Deposits were, in decreasing order of production, Sadiola Hill, Syama, and Morila. Deposits that were in the development stage were, in decreasing order of their resource potential, Loulo, Yatela, Segala, and Alamoutala.

The Sadiola Hill open pit gold mine, which is located 80 km southwest of Kayes, produced more than 19,000 kilograms (kg) (611,442 ounces) of gold in 2000, thus making it the second largest gold mine in West Africa. The mine was operated by the Société d'Exploration des Mines d'Or de Sadiola S.A. [a consortium made up of Anglogold Ltd. of South Africa (38%), IAMGOLD Corp. of Canada (38%), the Government of Mali (18%), and the World Bank's International Finance Corp. (6%)]. In September, a $1 million sulfide drilling program with the aim to delineate mineralization, particularly higher grade material that could support a significant deepening of the current open pit began. Resources are estimated to be 120 t of gold to be mined during a 12-year project life (IAMGOLD Corp., September 29, 2000, IAMGOLD gears up drill programs on six properties, accessed September 13, 2001, at URL http://www.iamgold.com/public-relations/press-releases/releases/prsept29-00.html; Mbendi Information Services, July 31, 2001, Mali—Mining—Gold mining, accessed September 13, 2001, at URL http://www.mbendi.co.za/indy/ming/gold/af/ml/p0005.htm.

The Syama open pit gold mine, which is located 75 km southwest of Sikasso in southern Mali, produced more than 8,000 kg (270,000 ounces) of gold in 2000. The mine was operated by Randgold (75%), the Government of Mali (20%), and the World Bank's International Finance Corp. (5%). In early 2001, operations were mothballed pending a return to higher gold prices. Syama has resources estimated to be 196,000 kg (6.3 million ounces) of gold (Mining Journal, 2001; Mbendi Information Services, July 31, 2001, Mali—Mining—Gold mining, accessed September 13, 2001, at URL http://www.mbendi.co.za/indy/ming/gold/af/ml/p0005.htm).

In July 2000, Randgold sold 50% of its 80% share in the open pit Morila gold mine, which is located 180 km southeast of Bamako, to Anglogold Ltd. for $132 million; the Government of Mali owned the remaining 20% (Financial Times, 2000). In 2000, about 4,400 kg (142,953 ounces) of gold were produced. In early 2001, the President of Mali officially opened the mine, which was expected to yield about 15,550 kg/yr (500,000 ounces per year) of gold during a minimum 9-year period (African Mining Bulletin, 2001).

In May 2000, work began on constructing the open pit Yatela gold mine, which is located 60 km southwest of Kayes and is 25 km north of the Sadiola Hill mine. Investment by Anglogold (40%), IAMGOLD (40%), and the Government of Mali (20%) totaled $75 million. Production was expected to begin in July 2001. The mine was to produce about 7,250 kg/yr during a 6-year period to yield about 43,500 kg (1.4 million ounces) of gold (Mining Journal, 2000e; IAMGOLD Corp. and Anglogold, October 12, 2000, First concrete for Yatela gold mine project in Mali, accessed October 17, 2001, at URL http://www.iamgold.com/public-relations/press-releases/releases/pr-oct12-00.html). About 12 km south of the Yatela deposit is the Alamoutala deposit, which has a resource of almost 5,000 kg (160,000 ounces) of gold. IAMGOLD and Anglogold plan to incorporate this into Yatela operations (Engineering & Mining Journal, 2000a).

Two additional notable gold deposits were also being examined for potential development in the near future. Randgold was said to be considering the development of the Loulo gold deposit, which is located in western Mali and has a resource estimated to be about 105,000 kg of gold (30.1 Mt at a grade of 3.49 g/t gold). In 1999, development of the deposit was halted owing to low gold prices (Mbendi Information Services, July 31, 2001, Mali—Mining, accessed September 13, 2001, at URL http://www.mbendi.co.za/indy/ming/gold/af/ml/p0005.htm). The Segala gold property, which is located in western Mali, has a gold resource estimated to be 42,350 kg (15.4 Mt at a grade of 2.75 g/t gold). In January, Semafo purchased Oliver Gold Ltd.'s (Canada) 75% share in the deposit (Semafo, Inc., May 25, 2000, Semafo, Inc. commences exploration work on Segala project in Mali, accessed September 13, 2001, at URL http://www.semafo.com/ press.php?id=24).

Numerous other mining companies had gold interests in Mali in 2000. Among them were the Canadian companies Etruscan Resources, Inc., Fancamp Resources Ltd., Golden Eagle International, Inc., Great Quest Metals Ltd., Nevsun Resources Ltd., Orezone Resources, Inc., and Robex Resources, Inc., and the Republic of Korea's Hyundai Corp.

In March 2000, the Export-Import Bank of China agreed to a $18 million loan to assist with the construction of a Sino-Malian cement plant via the China Overseas Engineering Company and local group Société Lou Kouma. The construction of the plant was anticipated to be completed in late 2001 with a capacity of 236,000 t/yr of cement (China Economic Information Network, March 22, 2000, Eximbank support JV overseas, accessed December 20, 2001, at URL http://ce.cei.gov.cn/enew/new_e1/e6200c63.htm).

In May, the Africa Development Fund approved a loan for $31.66 million to address Mali's underdeveloped transportation network. More specifically, the loan will go towards financing the multinational Kankan-Kouremale-Bamako road project in Guinea and Mali. The project will contribute to opening up Guinea's northeastern and Mali's southwestern regions and will involve the construction of a new 344-km road, 217-km in Guinea, and 127-km in Mali (African Development Bank Group, May 30, 2000, African Development Fund—Signing of a US $31.66 million loan agreement for the Kankan-Kouremale-Bamako road project [Guinea-Mali], accessed July 31, 2000, at URL http://www.afdb.org/knowledge/loans2000/adf_KKB_road_Guinea_Mali.htm).

MAURITANIA

In 2000, iron ore mining and beneficiation dominated the mineral industry in Mauritania. The country's GDP, which was based on purchasing power parity in 1999, was estimated to be $4.9 billion (U.S. Central Intelligence Agency, 2000, Mauritania—Economy, World Factbook 2000, accessed August 16, 2001 at URL http://www.odci/gov/cia/publications/factbook/geos/mr.html). Exports in 1999 were $333 million; iron exports of $178 million accounted for more than 50% of all exports (World Bank, September 9, 2000, Mauritania at a glance, accessed September 10, 2001, at URL http://www.worldbank.org/data/countrydata/countrydata.html). Mining employment occupied a small portion of the nation's population, which was estimated to be 2.7 million in July 2000. Principal mining output in 2000 included gypsum, iron ore, and salt. Mineral exploration interests were focused on diamond on the Archean Reguibat craton, gold in the Inchiri region, oil offshore, and continued evaluation of copper-gold, kaolin, and peat deposits.

The Ministère des Mines et de l'Industrie is the Government agency responsible for the mining industry in Mauritania. In August 2000, it appointed the Council for Geoscience in South Africa to provide technical supervision and advice to the Projet de Reinforcement Institutionelle de Secteur Minier (PRISM); PRISM is a 5-year program intended to accelerate the growth of the Mauritanian mining sector with a $16.5 million loan from the International Development Association of the World Bank. Projects include the production of a 1:500,000-scale geologic map of the nation and 1:200,000-scale maps of areas with mineral potential. PRISM began in September 2000 and was scheduled to run until 2004 (Mining Journal, 2000f).

In 1999, the Ministère des Mines et de l'Industrie adopted a new decree that outlines the rules concerning mining titles in the Mauritanian Mining Code. The Decret Portant sur les Titres Miniers (law No. 99/013) established four types of licenses for prospecting, exploration, exploitation, and small-scale mining exploitation. Under the decree, a prospecting license is valid for 6 months and renewable only for the same time period and does not grant any exclusive rights. Exploration licenses limit the area of exploration to 1,500 square kilometers (km^2) for all resources except diamond, which can be as large as 10,000 km^2. Exploration entities can acquire and maintain up to 20 licenses or 10 in the case of diamond exploration; these are valid for 3 years and can be renewed twice, each renewal not to exceed 3 years. An exploitation license confers on its holder, within the limit of the license perimeter and indefinitely in depth, the exclusive right of prospecting, exploring, and exploiting the mineral resources mentioned in the exploration license for a duration of 30 years; this license can be renewed. A small-scale mining license is for areas that do not exceed 2 km^2 and is granted for a period of 3 years up to a minimal amount of production determined by the Ministère des Mines et de l'Industrie; two renewals can be granted for a period of 3 years each after a negotiable level of production is reached or exceeded.

The Société Nationale Industrielle et Minière (SNIM) was responsible for iron ore production and beneficiation. SNIM operated three open pit iron ore mines at the Guelb El Rhein, the Kedia d'Idjill, and the M'Haoudat, each located in the Tiris region in northern Mauritania. In 2000, more than 11 Mt of iron ore was produced, most of which was exported to France, Italy, and Belgium (SNIM Group, 2000, Mauritania, accessed August 8, 2000, at URL http://www.snim.com/mine-port2.html; Mbendi Information Services, October 30, 2001, Mauritania—Mining—Iron ore mining, accessed December 19, 2001, at URL http://www.mbendi.co.za/indy/ming/iron/af/mu/p0005.htm.

In 2000, the Guelb Moghrein Project, which was being developed by Guelb Moghrein Mines d'Akjoujt S.A. of Mauritania, continued to be delayed owing to low gold and copper commodity prices as well as encountering problems at its pilot plant (Mbendi Information Services, January 12, 2001, Mauritania—Mining—Gold mining, accessed April 4, 2001 at URL http://www.mbendi.co.za/indy/ming/gold/af/mu/p0005.htm). The project, which is located within mining concession CM2 at Akjoujt, contains cobalt, copper, and gold resources that have been estimated to be 23.7 Mt at a grade of 1.88% copper, 1.41g/t gold, and 144 g/t cobalt with a 1% copper cutoff grade. In addition to the Guelb Moghrein Project, General Gold Resources NL of Australia held 7,600 km^2 of exploration permits in the Inchiri region near Akjoujt (General Gold Resources NL, 2000, p. 6-9).

In October, Rex Diamond Mining Corporation of Canada announced that results of exploration activities in the Karet South permit revealed concentrations of platinum, palladium, nickel, and gold. The combined concentration of platinum, palladium, other platinum-group metals, and gold averaged 1.64 g/t at a depth of between 18 and meters. Rex Diamond Mining also noted that more drilling was needed to assess the tonnage potential (Rex Diamond Mining Corporation, October 11, 2000, Rex Diamond Mining Corporation confirms concentrations of nickel, platinum, and palladium in Mauritania, accessed October 18, 2001, at URL http://www.rexmining.com/rdmc/Pressroom/2000/2000_10_11_E.htm).

Diamond exploration was among the principal exploration activities that took place in 2000. Ashton Mining Ltd. of Australia, Dia Met Minerals Ltd. of Canada, Rex Diamond Mining, and De Beers Consolidated Mines Ltd. of South Africa were all actively exploring for diamond. In November 2000, Rio Tinto plc of the United Kingdom acquired Ashton Mining Ltd. after its takeover bid of $712 million was accepted (Barry Fitzgerald, November 7, 2000, Today's Business—Rio beats De Beers for control of Ashton, accessed September 10, 2001, at URL http://www.theage.com.au/bus/20001107/A31264-2000Nov6.html). In July, Rex Diamond Mining announced a joint-venture agreement with De Beers, in which De Beers can earn up to a 60% interest in Rex Diamond Mining's 10,000-km^2 Akchar permit area if De Beers invests $24 million or produces a bankable feasibility study within 5 years. De Beers already owned a 3,426-km^2 permit in the same area (Mining Journal, 2000b).

In December, Rex Diamond Mining announced the discovery of another 8 kimberlites in Mauritania, thus bringing the total for the year to 17. Rex Diamond Mining also announced that microdiamond test analysis of samples from several of its previously discovered kimberlites show that diamonds were present (Mining Journal, 2000c; CanadaNews Wire, December 12, 2000, Rex Diamond Mining Corporation announces the discovery of a further 8 kimberlites in Mauritania, accessed December 28, 2000, at URL http://www.newswire.ca/releases/December2000/12/c2966.html).

Many international oil companies were involved in offshore oil exploration in Mauritania in 2000. In November, Woodside Petroleum Ltd. of Australia announced that it had taken a 35% interest in an offshore joint venture with Dana Petroleum plc of the United Kingdom, Elixir Corporation Pty. Ltd. of Australia, and Hardman Resources NL of Australia. The joint venture is in a 13,500-km^2 area in one of the northernmost areas in Mauritanian waters. Woodside was already operating in five other offshore areas where it has joined with British-Borneo Oil and Gas plc of the United Kingdom and Hardman. Woodside was expected to undertake three drilling projects each of which was expected to cost $25 million (Africa Energy Intelligence, 2000a).

An Algerian company operated the Somir Petroleum Refinery in the port of Nouadhibou under a management contract and processed imported Algerian crude oil. All refined products were consumed in country. The refinery had the capacity to treat 20,000 barrels per day of crude petroleum.

Electricity in Mauritania was generated and supplied by the Société Nationale d'Eau et d'Electricite. More than one-half of the installed capacity was generated by hydroelectric plants; the remainder was thermally fired (Mbendi Information Services, July 12, 2000, Mauritania—Electrical power, accessed February 2, 2001, at URL http://mbendi.co.za/indy/powr/af/mu/p0005.htm).

In 1999, Mauritania signed an agreement with France to upgrade its iron-exporting port of Nouadhibou. France's Fond d'Aide et de Cooperation approved a loan for $310,000 for the purchase of a computerized system to facilitate the checking and analysis of data (Africa Energy & Mining, 2000). Overall, the infrastructure of the country, in particular the road network, limited the development of the mineral industry in 2000.

NIGER

Uranium mining dominated Niger's mining sector in 2000. Niger's overall economy was led by agriculture in 2000; the GDP based on purchasing power parity in 1999 was $9.6 billion. In 1999, exports totaled $256 million; uranium ore was the primary export product accounting for 41% of exports. Niger's population as of July 2000 was estimated at 10.1 million (U.S. Central Intelligence Agency, 2000, Niger—Economy, World Factbook 2000, accessed August 16, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/ng.html; World Bank, September 12, 2000, Niger at a glance, accessed October 22, 2000, via URL http://www.worldbank.org/data/countrydata/countrydata.html). In addition to uranium, Niger also produced cement, coal, gold, gypsum, molybdenum, salt, and tin.

The Government agency responsible for mining is the Ministry of Mines and Energy. In November, the Government announced an offering of four oil exploration blocks with a number of tax exemptions. The exemptions include a complete waiver on taxes during the exploration phase; an exemption from duties and import tax on material, supplies, equipment and spares for oil operations; a waiver on taxes on bank loans; free import and export of oil products; and tax-free currency exchange and transfers. Once production begins, royalties will amount to 12.5% on oil and 5% on gas, and the corporate tax rate will be set at 45%. Exploration permits will be awarded for a 4-year period and be renewable twice for periods of 3 years apiece. In the case of a commercial discovery, a concession will be awarded for 15 years and be renewable for one additional 15-year period (Africa Energy and Intelligence, 2000c).

In an official ceremony in September, Niger's Prime Minister laid the cornerstone for the country's first gold mine, the open pit Samira Hill gold mine, which is located about 150 km west of the capital Niamey. The mine, which was intended to begin production in 2001 at a rate of 10,000 metric tons per day of ore, was owned by a consortium of Etruscan Resources (40%), Semafo (40%), and the Government of Niger (20%). An updated reserve study carried out by the Resource Service Group of Australia reported that the combined reserves of Samira Hill and the nearby Libiri deposit (also owned by the above consortium) were 10.1 Mt at a grade of 2.2 g/t with 19,200 recovered kilograms (reported as 618,036 ounces) of gold. The estimated mine life of these deposits is 6.3 years (Engineering & Mining Journal, 2000b; Semafo, Inc., [undated], Operations—Niger—Samira Hill project, accessed September 14, 2001, at URL http://www.semafo.com/operations_niger.html).

The Koma Bangou gold deposit was being developed by Etruscan Resources and the Government. In addition, GeoAfrica Gold Corp. of Canada had holdings close to the Algerian border. The Government estimated that production of artisanal gold was about 1 t/yr (Mbendi Information Services, March 6, 2001, Niger—Mining—Gold mining, accessed September 13, 2001, at URL http://www.mbendi.co.za/indy/ming/gold/af/ni/p0005.htm).

In 2000, Niger was the world's third largest producer of uranium after Canada and Australia (World Uranium Mining, June 2001, Nuclear issues briefing paper 41, accessed September 14, 2001, at URL http://www.uic.com.au/nip41.htm). Niger has two main uranium producing mines, the Akouta underground mine and the Arlit open pit mine, which are located in northern Niger. Cogema of France operated both mining operations that together produced 2,898 t of uranium in 2000; this was a decrease of 18 t from 2,916 t in 1999. Production costs have been high for these two mines, and uranium products are purchased under special agreements between the Niger Government and customers in France and Japan (Mbendi Information Services, March 6, 2001, Niger—Mining—Uranium mining, accessed September 13, 2001, at URL http://www.mbendi.co.za/indy/ming/urnm/af/ni/p0005.htm).

Soon after the Government announced an offer for four oil exploration permits, two of them located in eastern Niger were awarded to two U.S. companies, ExxonMobil Corp. and Hunt Oil Co. (Africa Energy Intelligence, 2000b). The Niger oil industry was regulated by the state-owned Société Nigérienne de Produits Pétroliers (Sonidep). Sonidep has the responsibility of not only representing the Government in all dealings concerning the country's petroleum resources, but importing petroleum products, and it owns most of the 10 petroleum storage depots in the country (Mbendi Information Services, March 27, 2001, Niger—Oil and gas, accessed September 14, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/ni/p0005.htm).

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TABLE 1
BURKINA FASO, MALI, MAURITANIA, AND NIGER: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
BURKINA FASO 3/						
Cement	thousand metric tons	30,000	40,000	40,000	50,000	50,000
Gold	kilograms	1,063 4/	1,089 4/	1,091 4/	886 4/	1,000
Manganese, Mn content of ore		10,000	1,000	1,000	--	--
Pumice and related volcanic materials		11,000	10,000	10,000	10,000	10,000
Salt		7,000	5,000	5,000	5,000	5,000
Stone, marble		110,000	100,000	100,000	100,000	100,000
MALI 5/						
Cement, hydraulic		12,000	10,000	10,000	10,000	10,000
Gold, mine output, gold content 6/	kilograms	4,329	16,323	20,562	23,688	25,000
Gypsum		500	100	500	500	500
Salt		6,000	5,000	6,000	6,000	6,000
Silver 7/	kilograms	270	800	900	1,000	1,000
MAURITANIA 8/						
Cement		100,000	80,000	50,000	50,000	50,000
Gold	kilograms	189	--	--	--	--
Gypsum		12,500	80,000	100,000	100,000	100,000
Iron ore:						
Gross weight	thousand metric tons	11,363 r/ 9/	11,703 r/ 9/	11,373 r/ 9/	10,401 r/ 9/	10,400
Iron content	do.	7,384 4/	7,605 4/	7,410 4/	7,475 4/	7,500

See footnotes at end of table.

TABLE 1--Continued
BURKINA FASO, MALI, MAURITANIA, AND NIGER: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
MAURITANIA--Continued 8/						
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	440	440	440	440	440
Gasoline	do.	1,900	1,900	1,900	1,900	1,900
Kerosene	do.	470	470	470	470	470
Distillate fuel oil	do.	1,100	1,100	1,100	1,100	1,100
Residual fuel oil	do.	2,450	2,450	2,450	2,450	2,450
Other	do.	700	700	700	700	700
Total	do.	7,060	7,060	7,060	7,060	7,060
Salt		5,500	5,500	5,500	5,500	5,500
NIGER 10/						
Cement, hydraulic		29,251 4/	30,000	30,000	30,000	30,000
Coal, bituminous		140,000	150,000	145,000	168,000 r/ 4/	158,000 4/
Gold	kilograms	1,000	1,000	1,000	1,000	1,000
Gypsum		1,800	1,800	2,000	1,502 r/ 4/	1,474 4/
Molybdenum concentrate, Mo content		10	10	10	10	10
Salt		3,000	3,000	2,000	2,000	2,000
Tin, mine output, Sn content		10	10	10	32 r/ 4/	22 4/
Uranium, U content		3,320 4/	3,497 4/	3,731 4/	2,916 r/ 4/	2,898 4/

r/ Revised. -- Zero.

1/ Table includes data available through October 22, 2001.

2/ Estimated data are rounded to no more than three significant digits.

3/ In addition to the commodities listed, granite, phosphate rock, sand and gravel, and other construction material are produced, but information is inadequate to make reliable estimates of output levels.

4/ Reported figure.

5/ In addition to the commodities listed, Mali produced clays, stone, and sand and gravel for local construction purposes in addition to diamond, marble, and tin, but information is inadequate to make reliable estimates of output levels.

6/ Excludes artisanal production, estimated to be about 2,000 kilograms per year.

7/ Estimated silver content of doré bullion.

8/ In addition to the commodities listed, modest quantities of crude construction materials (clays, sand and gravel, and stone) presumably were produced, but output was not reported quantitatively. The minimill of Societe Arabe de Fer et d'Acier en Mauritanie produced rebar and wire, but available information is inadequate to make reliable estimates of output levels.

9/ Reported by National Industrial and Mining Company.

10/ In addition to the commodities listed, phosphate rock, tungsten ore, and a variety of construction materials (clays, limestone, sand and gravel, and stone) were produced, but information is inadequate to make reliable estimates of output levels.

TABLE 2
SELECTED SIGNIFICANT GOLD DEPOSITS IN MALI IN 2000

Deposit	Company	Location	Production (kilograms)	Resources (kilograms)	Project life/status
Sadiola Hill	Société d'Exploration des Mines d'Or de Sadiola S.A. [Anglogold Ltd. of South Africa (38%), IAMGOLD Corp. of Canada (38%), the Government of Mali (18%), and International Finance Corp. (6%)]	80 kilometers southwest of Kayes	19,000	120,000	12 years.
Syama	Randgold Resources, Inc. (75%), Government of Mali (20%), World Bank's International Finance Corp. (5%)	75 kilometers southwest of Sikasso	8,000	196,000	Closed in early 2001.
Morila	Anglogold Ltd. (40%), Randgold Resources, Inc. (40%), and Government of Mali (20%)	180 kilometers southeast of Bamako	4,400	140,000	9 years.
Loulo	Randgold Resources, Inc., and Government of Mali	Western Mali	--	105,000	Development.
Yatela	Anglogold Ltd. (40%), IAMGOLD Corp. (40%), and Government of Mali (20%)	60 kilometers southwest of Kayes	--	43,500	6 years, starting in 2001.
Segala	Semafo Inc. (75%), Government of Mali (25%)	Western Mali	--	42,000	Development.
Alamoutala	Anglogold Ltd. (40%), IAMGOLD Corp. (40%), and Government of Mali (20%)	12 kilometers south of Yatela deposit	--	5,000	Do.

-- Zero.

THE MINERAL INDUSTRIES OF

BURUNDI, COMOROS, MALAWI, MAURITIUS, REUNION, RWANDA, AND SEYCHELLES

By Thomas R. Yager

BURUNDI

In recent years, Burundi, which is a small Central African country, has been known to produce columbium (niobium)-tantalum ore, gold, kaolin, tin, and tungsten ore, most of which has been designated for export (table 1). Additionally, the country has been known to produce limestone, peat, sand, and gravel for domestic consumption.

Burundi has numerous deposits of gold, particularly in Mabayi in the northwest, Muyinga in the northeast, Cankuzo in the east, and Tora-Ruzibazi in the west, where artisanal mining takes place. The Government has been trying to transfer technical skills to the artisanal miners; these efforts could raise the productivity of the gold mining sector and increase state revenues. Other efforts to develop the gold mining industry came from Burundi Mining Corp., which was a joint venture between the Government and private companies to explore the possibility of producing gold at Muyinga on a commercial basis (African Mining, 1998). The Muyinga deposit has estimated resources of 60 metric tons (t) of gold (Africa Energy & Mining, 1999).

In the northern provinces of Kayanza and Kirundo, deposits of cassiterite, columbite-tantalite, and wolframite associated with pegamatites are found. Artisanal mining of these minerals, which began over 30 years ago, has been contributing a small but increasing share of Burundi's export earnings (African Mining, 1998). Comptoirs Miniers de Burundi was mining these minerals and aimed to increase levels of production.

Burundi has notable resources of nickel and vanadium. Musongati, which was the largest deposit, was reported to have a nickel laterite resource of about 185 million metric tons (Mt) that grades 1.31% nickel, 0.08% cobalt, and 0.17% copper (0.8% nickel cutoff grade). The Nyabikere deposit has a laterite resource of 46 Mt that grades 1.45% nickel. The Waga deposit has resources estimated to be 35 Mt that grade 1.38% nickel. The deposit of vanadiferous titanio-magnetite in the Mukanda-Buhoro region has resources of nearly 10 Mt that grade 0.63% vanadium (African Mining, 1998).

Burundi is known to have deposits of rare-earth elements. From 1948 to 1978, 5,000 t of bastnäsite (an ore mineral for rare-earth elements) was produced at mines in Gakara. Operations were stopped to permit an evaluation of reserves. Resources of 5,000 t of rare-earth deposits have been found in five other regions of Gakara. Exploration projects for rare earths were also taking place at Murago and Nyanza-Lac, where these elements are found in monazite with heavy minerals, such as ilmenite, rutile, and zircon (African Mining, 1998).

A phosphate rock deposit in the region of Matongo was estimated to have resources of 17 Mt that grade 11% P_2O_5. Burundi's limestone deposits at Busiga and Ruzizi have resources of 2 Mt that grade 40.32% CaO and 2.2% MgO. Resources of other industrial minerals included 16.1 Mt of kaolin, 5.1 Mt of quartzite, and 730,000 t of feldspar in the northern part of the country (African Mining, 1998).

Deposits of platinum-group metals are known to exist in the regions of Nyabikere, Rutovu, and Waga. Deposits of uranium have also been discovered (U.S. Central Intelligence Agency, 2000a).

Since 1993, development of Burundi's resources has been inhibited owing partially to civil unrest and social strife. These conditions and economic sanctions imposed on Burundi by the Democratic Republic of the Congo, Ethiopia, Kenya, Rwanda, Tanzania, Uganda, and Zambia have negatively affected the country's economy and hindered foreign investment. According to the International Monetary Fund (1997, p. 46), Burundi's economy contracted by 23% between 1993 and 1996.

Although the economic sanctions were lifted in 1999, internal strife continued to hurt Burundi's economy. In May 2000, Andover Resources NL halted its feasibility study of the nickel mine at Musongati owing to risks to its personnel; this ended the possibility of starting mining operations before 2002. At the end of 2000, the civil war showed no signs of abating.

In 1999, Burundi's gross domestic product (GDP) amounted to about $4.2 billion at purchasing power parity, which was a decrease of about 1% compared with that of 1998 (U.S. Central Intelligence Agency, 2000a). The per capita GDP at purchasing power parity was $730. Manufacturing accounted for 7% of the GDP in 1999; construction, 5%; and mining and energy, about 1% total (International Monetary Fund, 2000a, p. 6).

Traditional fuels, such as firewood, charcoal, and agricultural residues, were used mostly for household and cooking needs. These fuels accounted for about 90% of Burundi's total energy requirements. Burundi's estimated resources of dried peat totaled 36 Mt; the current domestic market can absorb only 12,000 metric tons per year (t/yr) (African Mining, 1998). The state-owned company Office National de la Tourbe (ONATOUR) was responsible for the production and distribution of peat. Further exploitation of Burundi's peat resources is highly likely in the future owing to the depletion of the country's forests. The United Nations Food and Agriculture Organization (FAO) estimated that Burundi experienced an average deforestation rate of 9% per year during the 1990s; this was by far the highest rate in Africa (Afrol.com, January 24, 2001, World deforestation rate slows down—Outside Africa, accessed March 15, 2001, at URL http://www.afrol.com/Categories/Environment/env055_fao_deforestation.htm).

Most of Burundi's electricity was provided by hydroelectric power sources (98.43%), and the remainder was provided by fossil fuels (1.57%) (U.S. Central Intelligence Agency, 2000a). More than 80% of Burundi's electricity was generated by the Mugere and Rwegura stations. In 1999, Burundi's power production fell from 109.6 gigawatthours (GWh) to 98.3 GWh. This decrease of 11.4% was due to bad weather conditions, especially the drought that struck Burundi and its neighbors (Africa Energy & Mining, 2000).

In late 2000, Burundi and Rwanda jointly decided to build a hydroelectric power station on the Ruzizi River. Construction of the station was contingent upon approval from donor nations and institutions (African Energy Intelligence, 2000). Burundi's known exploitable potential hydroelectric energy was 1,366 megawatts (MW) (World Resources Institute and others, 1996, p. 288).

Burundi's transportation network comprised about 15,000 kilometers (km), of which slightly more than 1,000 km were paved. In March 2000, the Government reduced the weight limit of tanker trucks that bring fuel into the country in an attempt to preserve the country's crumbling roads (MBendi Information Services, 2000, Burundi—Oil and gas industry, accessed January 8, 2001 at URL http://www.mbendi.co.za/indy/af/bu/p0005.htm). The major waterway was Lake Tanganyika, which had a port at Bujumbura.

The outlook for the country's minerals industry and economy appeared static pending the resolution of political and social issues. If these issues can be resolved, the outlook for the minerals industry will depend heavily upon the global market; Burundi's domestic market is limited by its severe poverty. Gold and tin prices are unlikely to change substantially in 2001, and prices for tantalum are expected to rise owing to rapid growth in the market for electronic capacitors. Tungsten prices are also likely to increase because supply met only 80% of demand from 1997 to 1999. Prices started to rise in 2000 owing to declining shipments from stockpiles that were not fully replaced by production (MBendi Information Services, February 20, 2001, New report examines the tungsten industry, accessed February 27, 2001, at URL http://www.mbendi.co.za/a_sndmsg/news_view.asp?P=0&PG=15&I=16666&M=0). Other developments in 2000 that are likely to encourage growth included Burundi's joining with 19 other nations to form Africa's first free trade area (FTA) and pledges by the World Bank and other international donors to give $440 million in reconstruction aid to Burundi.

COMOROS

The Federal Islamic Republic of the Comoros is located on three main islands in the Mozambique Channel about two-thirds of the way between northern Madagascar and northern Mozambique. In 1998, the GDP of Comoros amounted to about $410 million at purchasing power parity. The per capita GDP at purchasing power parity was $725. The economy did not grow in 1998 (U.S. Central Intelligence Agency, 2000b). The International Monetary Fund (2000b, p. 2) estimated that manufacturing accounted for about 4% of GDP in 1999, and construction and public works, 6%.

In 2000, the mineral industry of Comoros continued to be limited to the production of common construction materials, such as clay, sand, gravel, and crushed stone, for local consumption. Cement was imported from Kenya and South Africa. Quantities were not available but were presumably very low because no significant construction projects had been noted in the press since the early 1980s. Geothermal energy resources are known within the territory.

The outlook on minerals output, however, was not expected to change significantly. The former French colony was dependent on imports to meet all its energy and cement needs. The economy of Comoros was based on the export of agricultural products, chiefly spices. Trade is likely to be boosted by the Government's decision to join the FTA. Political instability in recent years has continued to have a negative effect on the economy.

MALAWI

In recent years, Malawi, which is a small Central African country, has produced cement, coal, crushed stone for aggregates, dolomite, and limestone for domestic consumption (table 2). The country also produced small amounts of lime and artisanal salt. Malawi has been known to produce various gemstones, such as agate, amethyst, aquamarine, garnet, rubies, and sapphires. Coal from the Mchenga Mine and limestone were essential components of the country's cement and lime industries. The production of stone for aggregate and cement was a major component of Malawi's mineral industry. The country has known deposits of apatite, bauxite, corundum, granite, graphite, kaolin, kyanite, monzanite, phosphate rock, pyrite, salt, silica sand, tourmaline, uranium, and vermiculite.

In 1999, Malawi's GDP amounted to about $9.4 billion at purchasing power parity, and the per capita income was $940. Economic growth was 4.2% in 1999 (U.S. Central Intelligence Agency, 2000c). The World Bank (2000, p. 9) estimated the cost of rising oil prices to be 0.4% of Malawi's GDP in 2000 and 0.3% of its GDP in 2001. According to the International Monetary Fund (2001a, p. 51), manufacturing accounted for 13% of GDP in 1999; construction, 2%; and mining and quarrying, 1%. Mining and quarrying grew sharply from 1994 to 1999 owing to higher output of aggregates, cement, and coal (table 2; Coakley and Mobbs, 2001).

In 1999, Malawi's official mineral exports amounted to nearly $1 million, 95% of which was attributable to gemstones. Malawi exported gemstones to China, Germany, Italy, Japan, Norway, South Africa, and Thailand. Actual gemstone exports through informal channels exceeded $2 million (Malunga, 2000).

Malawi's precious and semiprecious gemstones were produced by artisanal miners who worked in 14 of Malawi's 25 districts. Quartz feldspar pegmatites, especially those in Chitipa, Mwanza, Mzimba, Nsanje, Ntcheu, and Rumphi contain amethyst, aquamarine, and rhodolite. Ruby and sapphire are found mainly in Mwanza, Nsanje, and Ntcheu (Ministry of Energy and Mining, 1997).

Malawi has five identified subbituminous coal fields. The Livingstonia coal field in northern Malawi (where the Mchenga coal mine is located) has estimated resources of 2 Mt of coal. The Livingstonia field has the coal with the lowest known average ash content and the highest known average calorific value in Malawi. In 1997, the largest consumers of Malawi's coal were the cement, soap, and textile industries (Ministry of Energy and Mining, 1997). Output dropped at the Mchenga

Mine in 1999 owing to aging machinery and an inability to obtain spare parts expeditiously.

The Ngaga coal field in northern Malawi was estimated to have resources of 15 Mt of coal, and the Mwabvi coal field's resources were estimated to be 4.7 Mt. The other known coal fields were the Lengwe in southern Malawi and the Nthalire in North Rukuru (Ministry of Energy and Mining, 1997).

Bauxite deposits on Mulanje Mountain were estimated to have a resource of nearly 29 Mt that grades 43.3% Al_2O_3 (Ministry of Energy and Mining, 1997). Malawi and Mozambique have discussed plans for using the Mulanje bauxite to supply Mozambique's Mozal aluminum plant. The project will require an investment of $800 million to start mining operations (Africa Mining Intelligence, 2000).

The Kayerekera uranium deposit in the North Rukuru Basin has a resource of more than 11,000 t of U_3O_8 from ore that grades 0.17% (Ministry of Energy and Mining, 1997, p. 5). Paladin Resources Ltd., which is the Australian mining company that acquired a 90% interest in the Kayerekera project in 1999, believed that recent developments in metallurgy and engineering, better infrastructure, and an improved investment environment in Malawi justify a new feasibility study on this deposit (African Mining, 2000).

In southern Malawi, Kangankunde Hill has an estimated resource of 11 Mt of monazite and strontianite that grades 2.0% rare-earth oxides (especially oxides of cerium, lanthanum, neodymium, and praseodymium) and 8% strontium (Ministry of Energy and Mining, 1997).

Heavy-mineral sands exist along the western lake shore in Salima in central Malawi. The beach sands contain garnet, ilmenite, monazite, and rutile and have about 670,000 t of heavy-mineral concentrate. Along the railway line at Tengani in central Malawi, an estimated 2.5 Mt of sands grade 3% ilmenite, and 300,000 t of sands, 0.3% rutile (Ministry of Energy and Mining, 1997).

Malawi's largest deposits of columbium (niobium) are at Ilomba Hill, Chilwa Island, and Thundulu. The deposit at Ilomba Hill was estimated to have a pyrochlore resource of 100,000 t that grades 3.0% Nb_2O_5. Chilwa Island has an estimated pyrochlore resource of 375,000 t that grades 0.95% Nb_2O_5, and Thundulu has an estimated pyrochlore resource of 900,000 t that grades 0.37% Nb_2O_5 (Ministry of Energy and Mining, 1997).

Malawi has considerable resources of industrial minerals. Phosphate rock deposits at Thundulu have an estimated resource of 2 Mt that grades 17% P_2O5. The limestone deposit on Malowa Hill has a proven resource of 4.08 Mt that grades 52% CaO and 0.99% MgO; it is suitable for the production of chemical grade lime. Proven dolomitic marble resources of 3.7 Mt grade 36.21% CaO and 12.99% MgO. The Mwanza District in southern Malawi has an estimated resource of 2.5 Mt of vermiculite (Ministry of Energy and Mining, 1997).

In central Malawi, deposits of kaolinitic clays have been mined at Linthipe. The resources from this deposit were estimated to be 14.1 Mt that grade 46.7% SiO_2, 33.8% Al_2O_3, 2.0% Fe_2O_3, 1.1% CaO, 0.26% MgO, and 0.28% K_2O +Na_2O. Linthipe clay is used for the manufacture of off-white- to white-firing earthenware products and refractories by Engineering and Foundry Co. (Ministry of Energy and Mining, 1997).

Deposits of silica sand near Mchinji have an estimated resource of 1.6 Mt that grades 97.2% SiO_2 and less than 0.2% iron oxide. These deposits may be suitable for the manufacture of pale green glass. The Lake Chiuta-Chirwa sand bar was estimated to contain 25 Mt of silica sand that grades 92.7% SiO_2 and 0.62% iron. The deposits may be suitable for the manufacture of brown glass containers, and further beneficiation may make the sand suitable for the manufacture of plate and window glass and reasonably clear glass containers (Ministry of Energy and Mining, 1997).

Deposits of graphite are plentiful in central Malawi. The Katengeza deposit was estimated to have resources of 2.7 Mt of ore that grade 5.83% carbon. Large graphite deposits have also been discovered at Chimutu (Ministry of Energy and Mining, 1997).

Malawi also has deposits of dimension stone. Deposits of sodalite syenite (blue granite) occur at Ilomba Hill, and a local company was exploring the possibility of producing stone blocks for export. Black granite deposits occur at Mkanda in Mchinji, central Malawi.

Malawi consumed 857 GWh of electricity in 1998. Hydroelectric power sources provided 97.61% of the country's electricity, and fossil fuel sources accounted for the remaining 2.39% (U.S. Central Intelligence Agency, 2000c). Malawi's known exploitable potential hydroelectric energy is 6,000 MW (World Resources Institute and others, 1996, p. 288). In late 2000, the Government of Malawi announced its attention to privatize petroleum marketing and distribution by 2002.

Malawi had about 28,400 km of roads, of which approximately 5,300 km were paved; the rail network covered nearly 800 km. Malawi Railways Ltd. was managed by the publicly owned Mozambican railway company CFM and the Nacala Corridor development company SDCN. Waterways include Lake Malawi and the Shire River.

The outlook for Malawi's mineral industry is tied to the Government's ability to face strong challenges, such as spurring exports, improving educational and health facilities, solving the environmental problems of deforestation and erosion, and dealing with the rapidly growing problem of HIV/AIDS (U.S. Central Intelligence Agency, 2000c). These challenges may be easier to meet after the debt relief granted to Malawi by the United Kingdom ($41 million) and the International Monetary Fund and World Bank ($1 billion) and Malawi's decision to join the FTA. Strong global demand for Malawi's minerals would also be helpful because the country's severe poverty limits its domestic market.

MAURITIUS

The Republic of Mauritius is located about 1,000 km east of Madagascar. In 1999, the GDP of Mauritius amounted to about $12.4 billion at purchasing power parity with per capita GDP of $10,400. The economy grew by 4% in 1999. Manufacturing accounted for about 29% of the GDP (U.S. Central Intelligence Agency, 2000d). The mineral industry of Mauritius was a negligible factor in an economy that was based chiefly on tourism, financial services, and the export of sugar and textiles. It maintained a favorable foreign investment climate and a Free Port Authority. Mauritius joined the FTA in 2000.

Historically, mineral output consisted of the local production and use of basalt construction stone, coral sand, lime from coral, and solar-evaporated sea salt. Data on production of minerals and construction commodities was not available, but on the basis of past activity, Mauritius produced about 1 million metric tons per year of stone, 300,000 t/yr of sand, 7,000 t/yr of lime, and 6,000 t/yr of salt. Environmental concerns regarding the mining of coral sand and its impact on coastal lagoons have been raised. All cement used in Mauritius was imported. A joint venture between Gamma Civil of Carl Ah Teck, which was a local firm, and Mehta Group of India has been launched in order to build a cement grinding plant in Mauritus.

Polymetallic nodules occurred on the ocean floor at a depth of about 4,000 meters and extended from 400 to 800 km north of Port Louis, which is northeast of Tromelin Island. The nodules averaged more than 15% each of iron and manganese and more than 0.3% of cobalt with a concentration averaging from 2 to 6 kilograms per square meter. The abundance of land-based resources of these commodities made it unlikely that these resources would be developed in the foreseeable future.

Although the country was totally dependent on imports for its energy requirements, oil possibilities of interest were east of the polymetallic nodules area offshore at shallower depth. In the 1970s, Texaco, Inc., explored the area by using geophysics and drilling; the results were inconclusive. Energy was consumed from oil-derived products (84.1%), electricity (10.5%), and coal (5.4%). Consumption of oil products was about 570,000 t in 1993, and grew at about 7% per year between 1993 and 1998 (MBendi Information Services, August 17, 1997, Mauritius—Overview—Oil industry profile, accessed September 15, 1997, at URL http://mbendi.co.za/indy/oilg/oilmrds.htm).

Steel reinforcing bars were made from imported ingot at three rolling mills. The near-term outlook for the exploitation of minerals other than construction materials was negligible.

REUNION

Reunion, which is an overseas department of France, is located about 650 km east of Madagascar. It had an economy that was dominated by sugar cane exports. In 1998, the GDP of Reunion amounted to about $3.4 billion at purchasing power parity with a per capita GDP of $4,800. The economy grew by 3.8% in 1998 (U.S. Central Intelligence Agency, 2000e). Production of mineral commodities represented only a small part of the economy of Reunion, although little quantitative information was available. Hydraulic cement was made by grinding imported clinker. The Ciments de Bourbon S.A. cement grinding plant at Le Port, which was owned by the Holderbank Group of Switzerland, had a capacity of 400,000 t/yr. Additionally, production of basic volcanic rock and seacoast coral undoubtedly continued to meet local construction needs. Little change in future mineral activity is anticipated.

RWANDA

In recent years, Rwanda's mineral industry has produced gold ores and concentrates of columbium (niobium)-tantalum, tin, and tungsten, most of which has been designated for export. This small central African country has also produced cement and small quantities of natural gas (table 3). The Rwandan mineral industry consisted mostly of a number of small cooperatives and individual artisanal miners that produced ores and concentrates from scattered locations generally in a zone about 30 km wide that extends east-west through Kigali. In 2000, the Rwandan Government privatized Régie d'Exploitation et de Développement des Mines, which was the state mining exploration company.

The deposits of methane under Lake Kivu were reported to have resources of more than 50 billion cubic meters (Worldinformation.com, 2000, Rwanda country profile, accessed March 1, 2001, at URL http://www.worldinformation.com/World/Africa/Rwanda/profile.asp?country=250). The country also is known to have deposits of beryllium, kaolin, and peat. Rwanda exploited its resources of beryllium from 1953 to 1985. In 1985, Rwanda produced 27 t of beryl concentrates that graded 10% BeO (Antonides and Morgan, 1993).

The Rwandan minerals industry (along with the rest of the country's economy) collapsed in 1994 owing to internal strife, and recovery has been inhibited by continuing instability. A series of massive population displacements, a nagging Hutu extremist insurgency, and Rwandan involvement in two wars during the past 4 years in the Democratic Republic of the Congo continue to hinder Rwanda's efforts (U.S. Central Intelligence Agency, 2000f). Other difficulties include a domestic market limited by a poverty rate of 65%, a shortage of skilled labor, and high transportation costs owing to the landlocked nature of the country (Wolfensohn, 2001). The recent increase in oil prices exacerbated Rwanda's problems with transportation costs and undermined the competitiveness of its exports. The World Bank (2000, p. 9) estimated the cost of rising oil prices and falling export prices to be 1.4% of Rwanda's GDP in 2000 and 1.2% of its GDP in 2001.

In spite of these difficulties, Rwanda has recovered most of the output lost in 1994. The World Bank estimated that the Rwandan economy grew at a rate of 5.2% in 2000 (Wolfensohn, 2001). The economic recovery has been particularly strong in the agricultural and construction sectors; the manufacturing sector has stagnated in the past 2 years. In 1999, Rwanda's GDP amounted to about $5.9 billion at purchasing power parity, which was an increase of about 5.3% from that of 1998. The per capita income at purchasing power parity was $720 in 1999 (U.S. Central Intelligence Agency, 2000f).

The International Monetary Fund (2001b, p. 4) estimated that manufacturing accounted for 11% of the GDP in 1999; construction, 8%; and mining, less than 1%. Tungsten and tin ores and concentrates accounted for 5% of Rwanda's exports (Worldinformation.com, 2000, Rwanda country profile, accessed March 1, 2001, at URL http://www.worldinformation.com/World/Africa/Rwanda/profile.asp?country=250).

Although the subsistence farming sector's energy needs were met by wood and charcoal, the exploitation of Rwanda's peat deposits may become necessary in the future owing to the depletion of the country's forests. The FAO estimated that Rwanda experienced an average deforestation rate of 3.9% per year during the 1990s; this was the third highest rate in Africa (Afrol.com, January 24, 2001, World deforestation rate slows down—Outside Africa, accessed March 15, 2001, at URL http://www.afrol.com/Categories/Environment/env055_fao_deforestation.htm).

Rwanda's industries and urban areas were the primary consumers of the 165 GWh of electricity used in 1998. Production of electricity totaled 159 GWh—hydroelectric power sources provided 97.48%, and fossil fuels, 2.52% (U.S. Central Intelligence Agency, 2000f). Rwanda's known exploitable potential hydroelectric energy is 3,000 MW (World Resources Institute and others, 1996, p. 288). In 2000, the privatization of Etablissement Public de Production, de

Transport et de Distribution d'Electricité, d'Eau et de Gaz ended the Government's monopoly over the production and distribution of water, gas, and electricity.

Rwanda's transportation network comprised about 12,000 km of roads, of which 1,000 km were paved. As of 1999, the country had no rail network. Lake Kivu was navigable by shallow-draft barges and native craft. Transportation costs are among the highest in Africa.

The outlook for Rwanda's mineral industry depends on the resolution of political instability and favorable world market conditions for columbium (niobium)-tantalum, gold, tin, and tungsten. Although domestic markets were limited, continued growth in the Rwandan economy could help the situation in the long run. Developments in 2000 that were conducive to faster economic growth included Rwanda's joining the FTA, the World Bank's grant of $15 million to deal with worsening terms of trade, and the decision by the International Monetary Fund and World Bank to grant $810 million in debt relief to Rwanda.

SEYCHELLES

The Republic of Seychelles is a group of 40 granitic and 50 or more coralline islands that is located northeast of Madagascar in the Indian Ocean. In 1999, the GDP of Seychelles amounted to about $590 million at purchasing power parity with a per capita GDP of $7,500. The economy grew by 1.8% in 1999. Manufacturing accounted for about 24% of the GDP (U.S. Central Intelligence Agency, 2000g). In 2000, Seychelles joined the FTA.

Mineral production in Seychelles consisted mostly of unspecified quantities of construction materials—clay, coral, sand, and stone. Although output of guano, which is a phosphate fertilizer that comprises bird droppings, ceased in the mid-1980s, a 5,000-t/yr-capacity plant remained, and small production was unofficially reported during the mid-1990s. Cement requirements were met from imports.

Granite in the bedrock of Mahe and nearby islands had some economic potential. It had been quarried for dimension stone on a trial basis by an Italian firm in the early 1980s. In 1992, Gondwana Granite of South Africa was granted a license to extract and export up to 3,000 cubic meters of granite for use in tile and statuary products. Lime and cement production from the abundant coral were under consideration. Preservationists and other environmentally concerned groups, however, opposed the granite and coral use projects. Polymetallic nodules were known to occur on the ocean bottom near the Admirante Islands.

The oil potential of the entire Seychelles region continued to be promoted by the Government-owned Seychelles National Oil Company (SNOC) through the Petroleum Mining Act of 1976. Tar balls from subsurface seeps have long been known to wash up on the beaches of Coetivy Island, Mahe, and some nearby islands. Exploration began in 1969, and by 1994, 23,150 km of seismic profiles and 27,911 km of aeromagnetic lines had been accumulated. Seychelles and Madagascar recently discussed joint efforts on oil exploration. A comprehensive report on the Seychelles geology, hydrocarbon potential, historical exploration activity, and geophysical data availability and on the terms of SNOC's model petroleum agreement is available on the Internet (MBendi Information Services, August 17, 1997, Oil industry—Upstream profile—Seychelles, accessed September 15, 1997, at URL http://mbendi.co.za/indy/oilg/oilgseus.stm).

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TABLE 1
BURUNDI: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/ 3/

Commodity		1996	1997	1998	1999	2000
Clays, kaolin	metric tons	1,000	1,000	1,000	800	800
Columbite-tantalite, mine output, ore (30% Ta_2O_5):						
Gross weight	kilograms	37,000 4/	46,000 4/	30,000 4/	42,000 4/	42,000
Ta_2O_5 content	do.	11,000	14,000	9,000	13,000	13,000
Gold, mine output, Au content	do.	2,200	1,500	1,500	1,500	1,500
Lime	metric tons	50	50	50	50	50
Peat	do.	10,000	10,000	10,300	17,000	14,700
Tin, mine output, Sn content	do.	25 4/	(5/)	23	10	10
Tungsten, mine output, W content	do.	16	16	10	10	10

1/ Data are rounded to no more than three significant digits.

2/ Includes data available through June 25, 2001.

3/ In addition to the commodities listed, small quantities of cement were produced until 1996; available information, however, is inadequate to make estimates of output.

4/ Reported figure.

5/ Less than 1/2 unit.

TABLE 2
MALAWI: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998 r/	1999 r/	2000 e/
Cement, hydraulic		91,000	175,800	134,000	186,500	198,000
Coal		69,930	63,210	54,200	43,800	44,900
Dolomite e/		1,100 r/	1,100 r/	1,210	1,330	1,360
Gemstones	kilograms	849 r/	351	934	649	665
Lime		3,150	1,940	2,600	2,900	3,080
Stone:						
Crushed for aggregate	cubic meters	58,700	162,538	182,600	71,700	76,200
Limestone, for cement		175,600 r/	258,000	171,900	171,900	183,000

e/ Estimated. r/ Revised.

1/ Estimated data are rounded to no more than three significant digits.

2/ Includes data available through June 25, 2001.

3/ In addition to commodities listed, modest quantities of salt and unlisted varieties of crude construction materials (clays, sand and gravel, and other stone) may also be produced, but information is inadequate to make reliable estimates of output levels.

TABLE 3
RWANDA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

Commodity		1996	1997	1998	1999	2000
Cement	metric tons	42,000	60,000	58,900 r/	66,300 r/	69,600 e/
Columbite-tantalite, ore and concentrate:						
Gross weight	kilograms	97,000 r/	224,000 r/	224,000 r/	122,000 r/	83,000
Nb content e/	do.	33,000 r/	76,000 r/	76,000 r/	41,000 r/	28,000
Ta_2O_5 content e/	do.	31,000 r/	72,000 r/	72,000 r/	40,000 r/	26,000
Gold, mine output, Au content	do.	1 r/	10 r/	17 r/	10 r/	10
Natural gas, gross e/	thousand cubic meters	970	100	100	100	100
Tin, mine output, Sn content	metric tons	260 r/	258 r/	260 r/	243 r/	345
Tungsten, mine output, W content	do.	49 r/	33 r/	149 r/	97 r/ e/	130 e/

e/ Estimated. r/ Revised.

1/ Estimated data are rounded to no more than three significant digits.

2/ Includes data available through June 25, 2001.

THE MINERAL INDUSTRY OF

CHAD

By Philip M. Mobbs

In 2000, minerals production in the Republic of Chad included about 120 kilograms of gold produced from alluvial placer deposits in the Mayo Kebbi area by artisanal miners. About 300,000 metric tons (t) of construction materials, which included aggregate from the Mani quarry at Dandi and gravel, sand, and silt from the Chari and the Logone Rivers, were produced. Clay was mined from numerous pits to manufacture brick. Limestone was recovered from the Louga quarry for local lime kilns. Approximately 12,000 t of natron (soda ash) was recovered from Lake Chad south and east of Liwa. About 9,000 t of salt was mined from various locations (Mining Journal, 2000; European Union, 1998, Chad—Section 4—Geology and mineral deposits, Country Profile, accessed August 25, 1998, at URL http://www.mines98.com/country/td/index.htm).

The mineral industry was becoming an increasingly significant segment of Chad's economy. Although overall mineral production was negligible in 2000, the 20-year hiatus in the commercial exploitation of the country's petroleum resources began to close in June when the World Bank approved a $93 million loan to finance the Government's interest in the the development of the Doba Basin and the export pipeline programs (World Bank, 2000).

In 1999 (the last year for which data are available), the gross domestic product (GDP) for the country was estimated to be $1.5 billion, and GDP per capita was estimated to be $200 (U.S. Department of State, 2000, p. 59). Chad's economy was largely based on agriculture, which accounted for about 40% of the GDP (Plant and others, 1999, p. 7). The nation's industrial sector suffered from low energy availability, high energy prices, and geographic and infrastructural isolation (U.S. Department of State, 2000, p. 4). In 2000, the economy continued to be affected by fuel supply and transportation problems (International Monetary Fund, July 6, 2000, Memorandum of economic and financial policies, accessed April 6, 2001, at URL http://www.imf.org/external/np/loi/2000/tcd/01/index.htm).

Chad's foreign trade essentially depended upon cotton, which accounted for about 65% of the foreign currency earnings of the country. The Government indicated that it would like to diversify the economy to alleviate the vulnerability associated with international market price oscillations for a single-export commodity. Adding petroleum to the country's exports would provide some diversification. In 1998 (the last year for which data are available), total exports were valued at $269 million. Fuel imports accounted for about 10% of total imports valued at $454 million. Construction material imports, such as cement, accounted for 6% of total imports, and unofficial estimates placed fertilizer imports about 3% of total imports (U.S. Department of State, 2000, p. 25, 27; World Bank, September 7, 2000, Chad at a glance, accessed September 20, 2000, at URL http://www.worldbank.org/data/countrydata/aag/tcd_aag.pdf).

Chad's legal system was based on French civil law and Chadian traditional law. There was a 45% corporate profit tax and a negotiable mining tax levied on the volume of material produced (Plant and others, 1999, p. 106; U.S. Department of State, 2000, p. 39, 45). Law No. 001/pr/99 addressed the management of oil revenues from the Doba Basin.

The Government proposed to compile an inventory of mineral resources. The Korea International Cooperation Agency was funding a study of mineral deposits in the Mayo-Kebbi region. Deposits of bauxite near Guidara; columbium (niobium)-tantalum in the Tibesti region; diatomite at Faya Largeau and at Koro Toro; graphite at Gabil and near Waya Waya; kaolin near Kelo and near Abou Déïa; limestone near Baoaré and in the north; marble at Dolko, Teubara, and in the Ouaddaï region; silica sand; soapstone near Léré; and tin and tungsten in the Tibesti region were reported, as were indications of chromite, copper, geothermal energy, iron, lead, nickel, radioactive minerals, titanium, and zinc deposits. Overall, Chad was relatively unexplored; any exploration activities in the near future, however, would be hampered by the rebellion in the north and by the presence of antitank and antipersonnel mines in the Borkou-Ennedi-Tibesti, the Guera, the Moyen Chari, and the Salamat regions (Mining Journal, 2000; U.S. Department of State, 2000, p. 7, 10; Direction de Recherches Géologiques et Miniéres, written commun., [undated]; European Union, 1998, Chad—Section 4—Geology and mineral deposits, Country Profile, accessed August 25, 1998, at URL http://www.mines98.com/country/td/index.htm).

In 2000, two petroleum development projects were in progress. Chad's recoverable crude oil resources were estimated to be 1 billion barrels, most of which were in the Doba Basin (U.S. Energy Information Administration, February 2000, Chad—Energy overview, Country Analysis Briefs, accessed November 2, 2000, at URL http://www.eia.doe.gov/emeu/cabs/chad.html).

Chadian oil resources in the Doba Basin have not been developed because of the limited local market demand and the lack of pipeline transport to the international market (Esso Exploration and Production Chad, Inc., [undated], The project—Exploration history and background, accessed September 19, 2000, at URL http://www.essochad.com/eaff/essochad/documentation/summary/2.html).

In April, Petroliam Nasional Bhd. (35% equity interest) and Chevron Overseas Petroleum Inc. (25%) joined Esso Exploration and Production Chad Inc. (EssoChad) (40%) in a consortium that would develop the Bolobo, the Komé, and the Miandoum Fields in the Doba Basin. Société Shell Tchadienne de Recherches et d'Exploitation and Elf Hydrocarbures Chad had withdrawn from the project in 1999. On June 6, the World

Bank approved financial support for the $3.7 billion development of the Doba Basin petroleum resources and the Chad-Cameroon pipeline project. In addition to the World Bank's $93 million loan to the Government, the International Finance Corp., which was an affiliate of the World Bank, was to provide a $100 million loan to the pipeline companies and was to compile $300 million in syndicated loans. The International Development Association, which was an affiliate of the World Bank, was providing $23.7 million to support Chad's environmental management and monitoring activities (World Bank, 2000). On October 18, 2000, ground was broken for the 1,070-kilometer (km), 760-millimeter (mm)-diameter Chad-Cameroon export pipeline. The pipeline was projected to carry crude oil for 25 to 30 years at volumes that could reach 225,000 barrels per day (bbl/d), or 575 million metric tons per year (Esso Exploration and Production Chad, Inc., [undated], Section 1—Project overview, Supporting Documents, accessed April 7, 2001, via URL http://www.essochad.com/eaff/essochad/documentation/english/sd_v1_toc.html). The export pipeline project continued to be controversial (Africa Energy Intelligence, 2000; Harry Dunphy, Associated Press, June 5, 2000, Africa oil project under fire, accessed June 5, 2000, at URL http://biz.yahoo.com/ap/000605/world_bank.html); Environmental Defense Fund, [undated], The Chad Cameroon oil and pipeline project—Putting people at risk, accessed June 28, 2000, at URL http://www.edf.org/pubs/reports/chadcameroon/index.html).

The consortium planned to drill an additional 289 production wells and 26 water disposal wells in the fields. Produced natural gas was to fuel an on-site powerplant. Produced water was to be reinjected. Oil resources at Komé were estimated to be 588 million barrels (Mbbl); at Miandoum, 227 Mbbl; and at Bolobo, 135 Mbbl. The American Petroleum Institute gravity of the crude ranged from 17 to 24 degrees, and sulfur, from 0.06 to 0.14 weight percent (Esso Exploration and Production Chad, Inc., [undated], Tables 2.1 and 2.2, Supporting Documents, accessed April 7, 2001, via URL http://www.essochad.com/eaff/essochad/documentation/english/sd_v1_toc.html).

The second petroleum project in Chad was the redevelopment of the Sedigui oilfield. Crude oil reserves at Sedigui were estimated to be 15 Mbbl (Hueper, 1999; Africa Energy & Mining, 2000b). The $95 million project included the redevelopment of the Sedigui oilfield and the laying of a 317-km, 100-mm-diameter pipeline from the field to a proposed oil refinery in N'Djamena. The new refinery capacity has been reported to be in the range of 3,000 to 5,000 bbl/d (Hueper, 1999; U.S. Department of State, 2000, p. 23). Concorp International Ltd. of Sudan was building the refinery that would have an refined product output of 1 million to 1.8 million barrels per year. In 1997 (the last year for which data are available), Chad imported about 630,000 barrels of petroleum products (Plant and others, 1999, p. 96). Excess fuel oil from the new refinery would be used to fire a new powerplant to be built in N'Djamena. The natural gas that will be produced at Sedigui was proposed as a fuel for additional electricity generation or to process and bottle natural gas in the form of compressed natural gas instead of flaring the gas at the field (United Nations Development Programme, [undated], Global environment facility—Operations—Portfolio, accessed April 6, 2001, at URL http://www.undp.org/gef/portf/climafr.htm).

Charcoal and wood were the primary fuel sources in the country. Societé Tchadienne d'Eau et d'Electricite (STEE) operated oil-fired electricity generation plants in Chad. The high cost of fuel imported from Cameroon and Nigeria resulted in high electricity costs. N'Djamena, which was the largest urban area in Chad, was approximately 1,400 km from Port Harcourt, Nigeria; 1,550 km from Douala, Cameroon; and 3,500 km from the port of Tripoli, Libya. Transportation costs made importation of fuel from Libya uneconomic (Plant and others, 1999, p. 90). The STEE's installed electricity generating capacity was 38 megawatts (MW), but actual generating capacity was significantly less, in part, because of the lack of capital investment (Elliot, 1991, p. 158; Plant and others, 1999, p. 10; U.S. Department of State, 2000, p. 22). Nationally, the adverse effects of frequent power failures were minimized because the STEE only served 6 of the country's 84 cities and towns (about 2% of the population of the entire country) (U.S. Department of State, 2000, p. 23; Ministry of Economic Promotion and Development, May 2000, National Poverty Reduction Strategy—Interim paper—Paragraph 53, accessed April 6, 2001, at URL http://www.imf.org/external/np/prsp/2000/tcd/01/index.htm). In January 2000, Vivendi Water and Dietsman of France entered a 2-year contract to manage the STEE with the option to lease the operation. EssoChad planned to construct a dedicated 120-MW-capacity powerplant to support its operations in the Doba Basin (Esso Exploration and Production Chad, Inc., [undated], Paragraph 4.1.9.1—Overview, Supporting Documents, accessed April 7, 2001, via URL http://www.essochad.com/eaff/essochad/documentation/english/sd_v1_toc.html). The Sedigui project reportedly included a 16-MW electricity generating plant to supplement power supplied to N'Djamena by the STEE (Africa Energy & Mining, 2000b).

Surface transportation in Chad was primarily over a road network, of which only about 300 km was paved; this includes about 40,000 km of seasonably passable roads and unimproved rural trails (Ministry of Economic Promotion and Development, May 2000, National Poverty Reduction Strategy—Interim paper—Paragraph 49, accessed April 6, 2001, at URL http://www.imf.org/external/np/prsp/2000/tcd/01/index.htm). Barge traffic was able to use the northward-flowing Chari and the Logone Rivers in the wet season for about 45 days per year (Esso Exploration and Production Chad, Inc., [undated], The Project—Section 5—Crude oil transportation alternatives, accessed September 19, 2000, at URL http://www.essochad.com/eaff/essochad/documentation/summary/5.html). There was no railway in Chad.

During the 30-year life of the Doba Basin project, Chad could earn up to $2 billion depending on oil prices. By 2004, when crude oil exportation was scheduled to be underway, Government revenues were expected to increase by 45% to 50% from current 2000 levels that could encourage investment in the building, education, health, and transportation sectors (Africa Energy & Mining, 2000a; World Bank, 2000).

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THE MINERAL INDUSTRY OF

CONGO (BRAZZAVILLE)

By George J. Coakley

The Republic of Congo [Congo (Brazzaville)] is located in equatorial central Africa between the Democratic Republic of the Congo [Congo (Kinshasa)] and Gabon and has an area of 342,000 square kilometers (km^2). In 2000, the area supported a population of more than 2.83 million, with a gross domestic product per capita of $1,530, based on 1999 purchasing power parity data (U.S. Central Intelligence Agency, 2000, The world factbook 2000—Republic of the Congo, accessed February 26, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/cf.html). Following the implementation of a formal cease-fire between the Government and resistance forces in January, the civil war, which began in 1997 and significantly damaged the economy and the land-based infrastructure, appeared to be at an end. The economy continued to be based largely on crude oil. Oil exports in 1999 (the last year for which trade data were available) declined to $850 million from $1.3 billion in 1998; owing to the sharp increase in oil prices, however, 2000 revenues are expected to be considerably higher. The value of all exports in 1999 was $1.7 billion.

Government Policy and Legislation

Investment is governed by the Investment Code of 1992 and the Hydrocarbon Law 24/94 of August 23, 1994, which regulates the terms of production-sharing agreements. The Hydrocarbon Law reduced taxes on crude oil production to 12% from 17.5% with the state-owned Societe Nationale des Petroles du Congo (SNPC; formerly Hydro-Congo) participating in a 31% profit sharing on all production. Mining legislation is based on Decree No. 29/62 of June 1962, as amended by Decree No. 23/82 of July 7, 1982, and Decree No. 86/814 of June 11, 1986. In general, mining has been carried out by the state or through state-owned joint ventures. Prior to the breakout of the civil war in 1997, a new mining code was presented to the National Assembly and Senate for consideration but apparently was not acted on.

Commodity Review

Cement.—Scancem International ANS of Norway (55%) signed an agreement with the Government (45%) to reopen the Loutete cement plant near Brazzaville, which was damaged during the civil war. Scancem, which withdrew from the country in 1996, will establish a new company, Les Ciments du Congo, to run the plant. The Loutete factory had a production capacity of 250,000 metric tons per year (t/yr), or about 50% of domestic requirements. The balance was imported from Congo (Kinshasa) and Gabon (Daily Mail and Guardian, October 2, 1999, Business briefs—Congo cements Norwegian deal, accessed April 10, 2001, at URL http://www.mg.co.za/mg/za/archive/99oct/02oct-business.html).

Copper, Lead, and Zinc.—AfriOre Ltd. of Canada held exploration permits on the Boko Songo copper prospect and the Yanga Koubanza lead-zinc-copper prospect, both of which are about 200 kilometers (km) west of Brazzaville. Although the company was not active in the Congo during 2000, it continued to seek potential joint-venture partners. Prefeasibility studies by AfriOre had identified 5.5 million metric tons (Mt) of carbonate-hosted ore at a grade of 7.95% lead, 6.97% zinc, and 1.87% copper at a 14% lead-equivalent cutoff at Yanga Koubanza and 2 Mt at a grade of 4.5% copper at Boko Songho. The company also reported locating high-grade copper mineralization at four other drilled prospects (AfriOre Ltd., 2000, Base metals, accessed April 10, 2001, at URL http://www.afriore.ocm/metals.htm).

Gold.—In November, Arena Gold Resources Inc. of Canada signed an agreement, subject to completion of its due diligence evaluation, to acquire a minimum 15% interest in the Yangadou gold mine in the Sangha Region from S.E.M.I., S.A., which was a Congo (Brazzaville) corporation. S.E.M.I. was owned (70%) by United Gold Finance International (Arena Gold Resources Inc., 2000).

Magnesium.—Significant resources of magnesium in the Makola and the Youbi magnesium salt evaporite deposits in the Kouilou region were being evaluated for development by Magnesium Alloy Corp. (MAC) of Canada. The $514 million Kouilou project would produce 60,000 t/yr of primary magnesium metal and high-purity magnesium alloys; a 2004 startup was planned. As a byproduct of the magnesium operation, salt, potash, and possibly chlorine also would be produced. Magnesium metal is used in castings and wrought products and in aluminum-based alloys used in automobiles, packaging, and other applications. In November, MAC presented to the Government the results of a technical feasibility study conducted by Salzgitter Anlagenbau GmbH of Germany. The study was based on solution mining of the these large magnesium salt deposits, which contained primarily tachyhydrite (9.4% magnesium) and carnallite (8.8% magnesium), and the use of a proven magnesium-extraction technology that had been developed by the Russian National Aluminum and Magnesium Institute and the Ukrainian Titanium Institute (Magnesium Alloy Corp., November 21, 2000, Kouilou magnesium project progress report, accessed April 2, 2001, at URL http://www.magnesiumalloy.ca/press/001121.htm). In September, MAC signed an agreement with AES Sirocco Ltd. of the United States to conduct a feasibility study on the energy component of the Kouilou project. If the project financing is obtained, then AES will be responsible for the financing, construction, and operation of the electrical power plant (Magnesium Alloy Corp., September 12, 2000, AES joins Kouilou magnesium project as power partner, accessed April 2, 2001, at URL http://www.magnesiumalloy.ca/press/ 000912.htm). A solution-mining well field of approximately 5 km^2 would be sufficient to supply the magnesium-extraction plant for 20 to 25 years. The energyintensive extraction process will require approximately 120 megawatts of electrical power and up to 120 million cubic meters per year of natural gas. MAC had an option to develop a hydroelectric dam 75 km north of the proposed plant on the Kouilou River or to draw on excess power from the Inga Dam in Congo (Kinshasa). Discussions were also underway on developing local gas reserves for the project. A detailed description of the Kouilou project is available at the company website at URL http://www.magnesiumalloy.ca/project/index.html.

Petroleum.—In September 1999, the assets of the Elf Aquitaine Group of France were merged with TotalFina of France. During 2000, the new company TotalFinaElf S.A. was the major operator in the petroleum sector and had a 60% share in Congo (Brazzaville)'s total crude production of 265,000 barrels per day (bbl/d). TotalFinaElf was operator of the Haute Mer permit and held a 51% production sharing interest. Other partners included Chevron Corp. of the United States (30%), SNPC (15%), and Energy Africa Ltd. of South Africa (4%). TotalFinaElf operated eight oilfields, all but one offshore; the Nkossa Field, which was the largest, produced about 70,000 bbl/d and had remaining recoverable reserves of 500 million barrels (Mbbl) of oil. TotalFina Elf began producing at a rate of 40,000 bbl/d from the new Kombi and Likalala fields within the Pointe Noire Grand Fond permit and expected to invest $135 million to develop four other small fields by 2004. Total national reserves were reported to be 1.5 billion barrels of oil and more than 90 million cubic meters of natural gas. All gas output, however, was vented or flared owing to a lack of extraction and distribution infrastructure (U.S. Energy Information Administration, October 2000, Country analysis briefs—Congo (Brazzaville), accessed April 12, 2001, at URL http://www.eia.doe.gov/emeu/cabs/congo.html). TotalFinaElf held minority interest and was operator in two other deepwater exploration permit areas, the Mer Profonde Sud and Mer Profonde Nord (MPN), where it hoped to expand the successful drilling of recently discovered deepwater oilfields just to the south in Angolan waters. In May, it announced its first discovery, Andromede Marine-1, in nearly 1,900-meter-deep water within the MPN block. The Andromede Marine-1 field tested at the rate of 7,000 bbl/d of high grade oil (TotalFinaElf S.A., 2000). Ente Nazionale Idrocarburi (ENI) of Italy (30%) and ExxonMobil Corp. (30%) also held interests in the MPN block.

ENI, which was the second largest producer, accounted for 27% of total production, or about 67,000 bbl/d of oil from three oilfields within the Pointe Noire Grand Fond permit area. A fourth field, Tchibeli, started production in 2000. ENI had two oilfields under development. The Foukanda field, in which ENI held a 65% interest, was expected to be in production during 2001 at a peak rate of 14,000 bbl/d and at a cost of approximately $128 million. The Mwafi field contained 40 Mbbl of oil equivalent and was expected to cost $80 million. Production was expected to start at a rate of 6,150 bbl/d in 2001 and to increase to a peak of 13,850 bbl/d by 2002. ENI expected oil production to average 78,000 bbl/d between 2001 and 2004 (Ente Nazionale Idrocarburi, 2000, ENI fact book 2000—Exploration and production—West Africa, accessed April 1, 2001, at URL http://www.eni.it/english/notizie/rapporti/fact_00/2_exploration_00.pdf).

In March 2000, the Congolaise de Raffinage (CORAF) oil refinery (controlled by SNPC) resumed production following a 2-year closure that resulted from the civil war. CORAF had a design capacity of 21,000 bbl/d but had operated at only about half capacity prior to the war (Alexander's Gas and Oil Connections, 2000).

Outlook

The year 2000 saw the beginning of the long process of restoring the Government, establishing a national dialogue, adopting a new constitution, and the resettlement of more than 800,000 people displaced during the war. The sharp upturn in oil prices and related revenues to the state along with renewed efforts to finance a major magnesium development suggested that the minerals sector could be a catalyst for economic renewal of the country.

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Major Source of Information

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TABLE 1
CONGO (BRAZZAVILLE): PRODUCTION OF MINERAL COMMODITIES 1/

Commodity 2/		1996	1997	1998	1999	2000 e/
Cement, hydraulic	thousand metric tons	43	20	--	--	20
Gold, mine output, Au content e/	kilograms	10	10	10	10	10
Lime e/	metric tons	390	390	390	390	390
Liquid petroleum gas (propane)	thousand 42-gallon barrels	75 r/	3,912 r/	4,384 r/	4,918	5,000
Petroleum, crude	do.	73,485 r/	85,424 r/	90,499 r/	93,951	96,700
Petroleum, refined 3/	do.	1,877	1,355	--	--	1,200

e/ Estimated. r/ Revised. -- Zero.

1/ Includes data available through April 2001.

2/ Natural gas is also produced, but all is vented or flared.

3/ Oil refinery ceased operations at yearend 1997 and reopened April 2000.

THE MINERAL INDUSTRY OF

CONGO (KINSHASA)

By George J. Coakley

The Democratic Republic of the Congo [Congo (Kinshasa)] is located in the heart of equatorial central Africa and has an area of 2,267,600 square kilometers (km²), which is about one-quarter that of the United States. The area supported a population of about 52 million in mid-2000, with a gross domestic product (GDP) per capita of $710 based on 1999 purchasing power parity data (U.S. Central Intelligence Agency, 2000, The world factbook 2000—Democratic Republic of the Congo, accessed February 26, 2001, at URL http://www.odci.gov/cia/publications/factbook/geos/cg.html). Historically, the mining industry accounted for 25% of the GDP and about three-quarters of total export revenues. Congo (Kinshasa) is richly endowed with such mineral resources as coal, cobalt, columbium (niobium)-tantalum (locally referred to as "coltan"), copper, diamond, germanium, gold, manganese, petroleum, tin, uranium, and zinc. Despite the collapse of much of its formal mining infrastructure, the country is an important world source of industrial diamonds and cobalt (table 1).

Responding to a tenfold increase in the world market price for tantalum from the $30-per-pound range to as high as $300 per pound during 2000, a strong financial incentive was behind the renewed interest in artisanal mining of columbium-tantalum ore in North Kivu Province. Tantalum is consumed mostly in the form of capacitor-grade metal powder by the electronics industry. Tantalum capacitors are used in portable telephones, pagers, personal computers, and automotive electronics.

The near collapse of the economy has made sustaining normal mining activities difficult; with some exceptions, most foreign exploration activity and development-oriented feasibility work came to a halt by the end of 1998. Following a 1-year hiatus, a new full-scale civil war broke out in August 1998 and was still ongoing in early 2001. The war has had a major impact on the region and has drawn in military support for the Government forces—the Alliance of Democratic Forces for the Liberation of Congo-Zaire (AFDL)—from Angola, Namibia, and Zimbabwe and military support for the rebel forces—which included factions of the Rally for Congolese Democracy (RCD) and the Movement for the Liberation of the Congo—from Burundi, Rwanda, and Uganda. Cross-border flows of refugees displaced from Rwanda or Congo (Kinshasa) have also impacted the economies of Tanzania and Zambia. Discord in the AFDL's military forces and the assassination of the President of Congo (Kinshasa) [its leader] on January 16, 2001, added further uncertainty to the future of the country.

A survey conducted by the New York-based International Rescue Committee estimated that more than 3 million people have died since the beginning of the conflict in August 1998, most not from fighting but from "starvation, disease and deprivation." The survey was conducted only in the RCD-held eastern half of the country, where most of the fighting and even more of the accompanying hardship has taken place. The toll would almost surely be higher if the Government-held western half was included (Karl Vick, Washington Post, April 30, 2001, Death toll in Congo war may approach 3 million, accessed May 1, 2001, at URL http://www.washingtonpost.com/wp-dyn/articles/A20629-2001Apr29.html).

During 2000, increasing international concern over the extent to which the country's mineral resources were being exploited by all factions to help finance the war or for personal gain led the United Nations (U.N.) Security Council to establish a panel of experts in June to investigate these allegations. Empaneled in August, the panel of experts was given 6 months to report its initial findings back to the U.N., which it did in early 2001. The panel said that "all belligerents in the war were benefiting in one way or another, with the Congolese people the only losers, and now the conflict was mainly about access, control and trade of coltan, diamond, copper, cobalt and gold, as well as timber, coffee and ivory" (United Nations Security Council, 2001, p. 41-42).

The report discussed the illegal exploitation of resources through confiscation, extraction, forced monopoly, and price fixing. References are made to the illegal transfer of stockpiled ore owned by Société Minière et Industrielle du Kivu (SOMINKI), which included 2,000 to 3,000 metric tons (t) of cassiterite (tin ore) and 1,000 to 1,500 t of coltan from North Kivu Province to Rwanda between November 1998 and April 1999; illegal gold mining by civilians and military; tributes paid by artisanal miners to occupying soldiers to exit gold mining areas; the use of prison labor to mine coltan by Rwanda; and the organized export of exploited resources through Rwanda and Uganda. The panel recommended that the Security Council immediately declare a temporary embargo on the import or export of cassiterite, coltan, diamonds, gold, pyrochlore, and timber from or to Burundi, Rwanda, and Uganda and that all countries should abstain from facilitating the import or export of these resources. Other nonmilitary recommendations included freezing the financial assets of rebel movements and companies or individuals involved in the illegal exploitation of natural resources (United Nations Security Council, 2001, p. 42-44).

The Washington Post further described the "wild West" atmosphere that surrounded coltan mining in North Kivu Province, and how, on the Government side, the granting of mineral concessions to military allies has been well documented— offshore oil wells to Angola, diamond and cobalt to Zimbabwe, and a share of a diamond mine to Namibia. The Washington Post article quoted an RCD source as saying the RCD "raised more or less $200,000 per month from diamonds, and that col- tan gives us more: a million dollars a month" (Vick, 2001).

Government Policies and Programs

Legislation has been passed relating to all aspects of the mineral industry. Article 10 of the April 1994 Constitution states that the soil and subsoil belong to the state. Prospecting, exploration, and exploitation were regulated by Ordinance No. 81-013 of April 2, 1981, and required permits from the Ministry of Mines and Energy. The Ministry was working on developing a new mining and foreign investment law during 2000 and was expected to announce the details in early 2001, although the presidential assassination and the resulting changes in the Government may delay the announcement.

Production and Trade

As estimated in table 1, production of the more important commodities decreased from that of 1999. Cobalt and copper were down by 26% and 34%, respectively, as the state-owned La Générale des Carrières et des Mines (Gécamines), which had been historically the nation's major foreign currency export earner, continued its struggle to maintain copper production at 5% to 10% of capacity. Diamond production appeared to decline by 12%, but exact figures are uncertain owing to the high level of smuggling and undocumented production. Crude petroleum production increased by 19% to around 28,200 barrels per day (bbl/d). Officially reported gold production was around 52 kilograms (kg); undocumented gold production in RCD-controlled areas, however, could range from 3,000 to 6,000 kg. Likewise, reports of columbium-tantalum concentrate production vary widely; the tenfold increase in tantalum prices, however, would make an estimate of at least 450,000 kg of concentrate not unreasonable given the identified mineral resources and obvious financial incentives. Historically, the main trading partners of Congo (Kinshasa) were Belgium, France, Germany, Japan, South Africa, and the United States.

Structure of the Mineral Industry

The Government maintained at least part ownership and generally majority ownership of nearly all the productive and service sectors of the economy. Gécamines produced essentially all of the country's coal, cobalt, and copper. It also operated subsidiaries that produced cement and other materials required for its primary mineral interests. Société Minière de Bakwanga (MIBA), which was 80% owned by the Government, produced about 25% of industrial diamond production from the Government-controlled lands in Kasai-Occidental and Kasai-Oriental Provinces, with the remainder coming from small artisanal operators. The columbium-tantalum, gold, and tin producer SOMINIKI and major gold producer Office des Mines d'Or de Kilo-Moto (Okimo) were the other principal parastatal mining companies. The majority of SOMINIKI and Okimo holdings were in rebel-held areas in eastern Congo (Kinshasa).

During 1997 and for more than half of 1998, prior to the renewed outbreak of the current civil war, Gécamines used joint ventures to attract the capital needed to revitalize operations. Foreign investors retained up to 49% equity interest in these joint-venture arrangements, most of which ranged from 20% to 45%. By the beginning of 1998, Gécamines had 23 cooperative projects, which included development of the Tenke-Fungurume deposits, that it hoped would return production levels of copper to 400,000 t and cobalt to 25,000 t. During 2000, however, most of these projects were either on force majeure hold or proceeding cautiously with feasibility work.

Commodity Review

Metals

Copper and Cobalt.—Gécamines holdings in the Copper Belt in Katanga Province contained one of the greatest concentrations of high-grade copper and coproduct cobalt resources in the world. Since 1993, most mining operations have come to a standstill, with total capacity utilization at less than 10%. Gécamines faced multiple crises in finance, production, and transportation. The company's poor condition was attributed to a combination of aging equipment; lack of domestic and international investment; lack of spare parts; shortages of fuel, lubricants, and sulfuric acid; problems with transporting ore and finished products; theft of finished products; debts owed to the state electrical company and Société Interrégionale Zaïroise de Rail (Sizarail); flooding of open pit mines; and the inability to retain professional and other personnel because of disruptions caused by the war and other factors. Société Nationale des Chemins de Fer du Congo has taken over the holdings of Sizarail.

During 2000, OM Group, Inc. (OMG), of the United States, which was one of world's largest consumers of refined cobalt, and l'Enterprise Generale Malta Forrest SPRL began to produce at full capacity from their Luiswishi copper-cobalt project. OMG had a long-term contract for approximately 5,000 metric tons per year (t/yr) of cobalt and 9,000 t/yr of copper on a right of first refusal. OMG's $110-million Big Hill cobalt smelter in Lubumbashi began production in the fourth quarter of 2000; full operational capacity of 5,000 t/yr was expected during 2001. The smelter was treating an adjacent slag stockpile, which was sufficient to supply the plant for 20 years. Concentrates produced were shipped to the OMG Kokkola chemical plant in Finland (OM Group, Inc., 2001, p. 3, 7).

In March 1998, First Quantum Minerals Ltd. of Canada signed two agreements with Gécamines for the retreatment of large high-grade copper-cobalt tailings dumps—the Kingamiambo and the Luilu tailings dumps, which are located in the Kolwezi District, and the Panda and the Shituru tailings dumps, which are located at Likasi. During 1999, First Quantum completed its initial feasibility study on the project and announced mineral-resource estimates for the four tailings dumps but then curtailed development activities owing to the political situation. The company continued to pursue financial partners for what it described as economically robust projects once the political climate stabilizes.

First Quantum reported no activity on these projects during 2000. In February 2001, however, Mopani Copper Mines PLC of Zambia, in which First Quantum held a 44% interest, began negotiations with Gécamines to exploit jointly the ore deposits at Luansobe. Mopani is an extension of the Mufulira Mine that stretches across the border from Zambia into Congo (Kinshasa). Ore from the Luansobe ore deposit would be processed in Zambia and would extend the lifespan of Mufulira Mine from the 2000 estimate of 15 years to 25 years (Lewis Mwanangombe, Panafrican News Agency (Dakar), February 23, 2001, Mopani Copper Mines Plc in negotiation with Gécamines, accessed April 10, 2001, at URL http://allafrica.com/stories/200102230120.html).

Anvil Mining NL of Australia and First Quantum [its minority partner (16.5%)] held a mining convention (concession) for the right to explore and develop the Dikulushi copper-silver deposit in southeastern Congo (Kinshasa) near the Zambian border west of Pweto and Lac Moero. During 1998 and 1999, the company completed feasibility and metallurgical design studies on the high-grade copper-silver Dikulushi deposit. Copper-silver concentrates produced would be treated at the Mopani Copper Mines smelter and refinery facilities in Zambia. Although the project was on hold during 2000, Anvil indicated that it was prepared to proceed with the staged development of Dikulushi as soon as the political climate risk was acceptable (Anvil Mining NL, April 30, 2001, Quarterly report for period ending March 31, 2001, accessed April 30, 2001, at URL http://www.anvil.com.au/qtreports/2001/avl310301.htm).

Tenke Mining Corp. (TMC) of Canada (55%) in joint venture with Gécamines (45%) held the concession to develop the 1,437-km^2 Tenke Fungurume copper-cobalt deposits located within two concessions approximately 175 kilometers (km) northwest of Lubumbashi in Katanga Province. In December 1998, TMC concluded an option agreement with BHP World Exploration Inc. of Australia whereby BHP would directly or indirectly acquire a 45% ownership interest in the Tenke Fungurume concession in return for providing certain development funding. In February 1999, TMC exercised the force majeure provisions of its agreement with Gécamines that released TMC from meeting certain binding dates to complete a final bankable feasibility study, which was nearing completion, and recognizing the difficulty Gécamines would have in meeting its responsibility for providing power supply, transportation, and certain construction resources associated with the project. A description of the project is available at the company website (Tenke Mining Corp., 2000, Projects—Tenke Fungurume, accessed April 10, 2001, via URL http://www.tenke.com). TMC reported that it had been continuing work on the preparation of technical and economic studies related to the potential future development of Tenke Fungurume since mid-2000 and that in May 2001, Phelps Dodge Corp. of the United States had signed an agreement to earn up to 50% of BHP's option interest in the project (Tenke Mining Corp., May 3, 2001, Phelps Dodge joins in BHP's option agreement with Tenke for the Tenke Fungurume copper-cobalt project in DRC, accessed May 3, 2001, via URL http://www.tenke.com).

Melkior Resources Inc. of Canada, which has had a presence in Congo (Kinshasa) since 1996, operated under Société Minière de Kabolela et de Kipese (SMKK), which was a local company. SMKK [controlled by Melkior (60%) and Gécamines (40%)] owned the Kabolela copper-cobalt mine and the Kipese cobalt-palladium-gold exploration property discovered by Melkior. Gécamines reported minable reserves at the Kabolela Mine to be 3.6 million metric tons (Mt) at a grade of 3.81% copper and 0.68% cobalt in addition to a resource of 3.3 Mt at a grade of 3.145% copper and 0.84% cobalt. SMKK treated the first batch of Kabolela ore at the Kakanda concentrator in 2000. The concentrator treated 6,023 t of ore at a grade of 2.81% copper and 1.01% cobalt, thus producing 508 t of concentrates at a grade of 16.02% copper and 5.4% cobalt that contained 81 t of copper and 27.4 t of cobalt. SMKK was expected to produce around 1,600 t/yr of cobalt at full capacity (Melkior Resources Inc., 2000, p. 3-4).

International Panorama Resources Corp. (IPR) of Canada, which had acquired a 51% working interest in the Kambove and the Kakanda copper/cobalt tailings reprocessing projects from Gécamines in August 1996, completed feasibility studies in 1997 that called for a $270 million investment to develop the projects. During 1999 and 2000, IPR provided no public updates on the status of its continuing interest in the project.

American Mineral Fields Inc. (AMF) of the United States had a 50-50 joint venture with Anglo American plc, through which it held a 60% majority interest in Congo Mineral Developments Ltd. (CMD); Gécamines owned 40%. CMD operated the Kolwezi copper-cobalt tailings project. Early in 2001, CMD renegotiated its agreement with Gécamines to allow for the development of the project in two phases. With an investment of $330 million in phase I, the plant will treat approximately 3 million metric tons per year (Mt/yr) of tailings, which will yield up to 42,000 t/yr of copper and 7,000 t/yr of cobalt. Phase II would double the rate of treatment. Negotiations on a timetable for completing the feasibility study and arranging financing were ongoing (American Mineral Fields Inc., April 2, 2001, AMZ first quarter 2001 update—Letter to shareholders, accessed May 1, 2001, at URL http://www.am-min.com/reports/2001/Shareholder%27s%20Report.pdf).

Gold.—Société Aurifère du Kivu et du Maniema S.A.R.L. (Sakima) was established in January 1997 to operate the former SOMINIKI gold, tantalum, and tin mines and other landholdings in the region. Sakima was controlled by Banro Resource Corp. of Canada (93%) and the Government (7%). The old SOMINIKI holdings included 10 mining permits and 47 mining concessions that covered 10,271 km^2. Gold holdings southwest of Bukavu in South Kivu Province included the Kamituga-Mobale underground gold mines, which were forced to close during the 1997 civil war, and the Lugushwa, the Namoya, and the Twanziga gold properties. By the presidential decrees of July 29, 1998, however, without prior warning or consultation with Banro, the Government dissolved Sakima, through which Banro held its mineral properties and carried on business in Congo (Kinshasa); terminated the company's mining convention that related to the company's mineral properties; created Société Minière du Congo S.A.R.L. (Somico); and appointed certain Government nominees as officers of Somico. The action put Banro's ownership of certain Sakima mining concessions and related assets in question (Banro Resource Corp., March 19, 1999, Uncertainty regarding interest in the Democratic Republic of Congo—Consolidated financial statements—December 31, 1998 and 1997, accessed April 1, 1999, at URL http://www.banro.com/123198.html).

In accordance with the provisions of its mining convention with the Government, Banro filed a suit for $1 billion in compensation claims with the International Center for the Settlement of Investment Disputes (ICSID); it was accepted for arbitration in October 1998. In September 2000, following ICSID tribunal meetings and the submission of legal briefs by both sides in 1999 and 2000, the ICSID declined to exercise jurisdiction over the Banro claims. In January 2001, through its U.S. subsidiary, Banro filed suit against the Government of Congo (Kinshasa) in the U.S. Federal courts in Washington, DC, pursuant to provisions of the U.S. Foreign Sovereign Immunities Act (Banro Resources Corp., 2000a, b; 2001).

In joint venture with AngloGold Ltd. of South Africa, Barrick Gold Corp. of Canada held a 57,000-km^2 exploration concession near the Kilo-Moto goldfields in the Bunia area of northern Congo (Kinshasa) and adjoining Sudan to the north and Uganda to the east. Ashanti Goldfields Co. Ltd. of Ghana held a 86.2% interest in the 2,000-km^2 Kilo-Moto Mining International S.A.R.L. concession in rebel-controlled Orientale Province. Owing to the war, Ashanti and Barrick conducted no field activity on these holdings during 2000.

Manganese.—Cluff Mining PLC of the United Kingdom was in a joint venture with the state-owned Enterprise Minière de Kisenge-Manganese to revive the Kisenge manganese ore mine and to increase manganese production to 40,000 t/yr. The Kisenge Mine, which was formerly owned by Belgium's BCK Manganese Co., was nationalized in 1974 and had been completely dormant since about 1990. The company had a 540,000-t stockpile of manganese carbonate ore at a grade of 47% to 50% manganese (Mbendi Information Services, November 29, 2000, Democratic Republic of Congo—Mining industry—Manganese mining, accessed December 22, 2000, at URL http://mbendi.co.za/indy/ming/mang/af/zr/p0005.htm).

Zinc.—Under a 1998 extension of an August 1996 framework agreement between AMF and Gécamines, AMF had a commitment to prepare a feasibility study on the reopening of the Kipushi underground zinc-copper mine, rehabilitating the concentrator, and reprocessing the existing tailings. In August 2000, AMF signed an option agreement with zinc smelting company Zinc Corp. of South Africa (Zincor) for Zincor to earn up to a 50% interest in Kipushi by investing up to $3.5 million. During its due diligence study, Zincor concluded that a small-scale phase I project could be economic at a production rate of concentrates that contained 30,000 to 50,000 t/yr of zinc, and it exercised its option. A full phase I feasibility study was scheduled for 2001. The partners were still negotiating for a final mining concession from the Government, ratified by presidential decree, to operate the Kipushi Mine and determining the fiscal terms of its arrangement with the Government (American Mineral Fields Inc., April 2, 2001, AMF first quarter 2001 update—Letter to shareholders, accessed May 1, 2001, at URL http://www.am-min.com/reports/2001/shareholder%27s%20Report.pdf).

Industrial Minerals

Diamond.—MIBA accounted for about one-quarter of the total national production of diamonds from mining operations in Mbuji Mayi in Kasai-Oriental Province. MIBA was owned by the Government (80%) and Sibeka Group (20%) [owned by Union Minière of Belgium (79%) and De Beers Centenary AG (20%)]. MIBA produced 4.8 million carats per year of low-value near-gem-quality stones in 1999; this was a decrease of 30% compared with that of 1998. Production in 2000 was estimated to be 4.5 million carats; the actual production, however, is uncertain owing to reports that some diamond concessions were awarded to countries that were providing military aid to the Government. In July 2000, the Government reportedly signed an agreement with International Diamond Industries of Israel that gave the company the exclusive right to export diamonds from state- owned mining operations in return for a payment of $20 million. After currency controls failed to halt the smuggling of diamonds, the Government felt this arrangement would more effectively control the security and the origin of diamond production from Congo (Kinshasa) to distinguish them from illegally mined "conflict" diamonds (Namibian, August 9, 2000, DRC gives diamond monopoly to Israelis, accessed September 2, 2000, via URL http://www.namibian.com.na).

Mineral Fuels

Congo Gulf Oil Co. [owned by Chevron Corp. of the United States (50%), Teikoku Oil Co. Ltd. of Japan (32.3%), and Unocal Corp. of the United States (17.7%)] produced approximately 17,000 bbl/d of crude petroleum from seven offshore wells in 2000. Congo Gulf Oil accounted for about 60% of national petroleum production. The only domestic oil refinery, which was at Muanda, had a rated capacity of 17,000 bbl/d. Other companies that were operating in Congo (Kinshasa) included Ocelot International Ltd. and Japan National Oil Co.

Reserves

Major mineral resources were generally considered to be sufficient for many years of production with known copper ore grades running two to eight times the grade of typical copper ore mined in North America and South America. Reserve data on cobalt, copper, diamond, gold, and zinc, however, have not been updated for several years and must be reevaluated in light of current (2000) economic conditions in Congo (Kinshasa) and the deterioration of Gécamines mines and other facilities. Reserves of oil, gas, and coal were estimated to be 187 million barrels, 1 billion cubic meters, and 88 Mt, respectively (U.S. Energy Information Administration, February 2001, Country analysis briefs—Southern African Development Community, accessed April 8, 2001, at URL http://www.eia.doe.gov/emeu/cabs/sadc.html).

Infrastructure

Congo (Kinshasa) is an essentially landlocked country with only a small coastal area on the Atlantic Ocean. The main port of Matadi, which has a 160-km river approach, has had difficulty operating at its 2-Mt/yr cargo capacity. Waterfalls below the capital of Kinshasa make the Congo River unnavigable to the sea and limit the world's second largest river as a significant export route, although it is a key inland commercial route.

A combination of air, railroad, road, and riverboat transport was used to move equipment, food, and other supplies into the mining and mineral-processing regions and for exporting ores, concentrates, and finished mineral products. Even prior to the breakout of civil war, much of this transport network was in varying degrees of disrepair. Locomotive and rolling stock shortages were also a problem. Sizarail was a critical logistical support link for the diamond industry between the Zambian border and Mbuji Mayi.

The major companies involved in transportation were Government-owned. Small private trucking and riverboat companies provided limited local service. Historically, mineral products were sometimes shipped from the Copper Belt westward on the Voie Nationale, which was a difficult road-rail-water route and the only transport route entirely within the country to Matadi; eastward through Zambia on the Tazara railroad to the port of Dar es Salaam in Tanzania; or southward through Zambia on rail lines that led to bulk-loading export ports in South Africa. Copper shipments could take 45 days to get from the plant to the dock either south via Zambia and Zimbabwe or eastward along the Tazara railroad via Zambia and Tanzania. Owing to rail and river transport problems, most cobalt and copper wirebar products were shipped via truck convoy to the port of Durban in South Africa. High-value cobalt, diamond, and gold were commonly flown out of the country.

Katanga Province, which is the site of most of the country's mining activity, historically consumed almost 50% of the nation's generated electrical power. A portion of the electricity used in the Katanga region was delivered by the 1,800-km-long, 560-megawatt Inga-Shaba transmission line, which runs from the Inga Dam on the Congo River south of Kinshasa to the Copper Belt city of Kolwezi in Katanga. Nevertheless, the tremendous hydroelectric potential of the Congo River remained largely untapped. For energy requirements at its mine and metallurgical operations, Gécamines was dependent on imported coke and refined petroleum products.

Outlook

The short-term economic prospects for Congo (Kinshasa) are poor and further threatened by the ongoing civil war, quick turnovers of administrations, and refugee problems and ethnic conflicts in the eastern provinces bordering Rwanda and Uganda. The decline of copper and cobalt production during the 1990s has led to the deterioration of Gécamines, which is the country's most important company. Despite almost insurmountable operating difficulties, Gécamines continued to operate, albeit at limited capacity. Changing Government policies that promote privatization of the state-run mining sector to attract new foreign capital and technical expertise holds some hope for the future but requires stronger guarantees of property title and investment security by the Government. Lack of transparency in business transactions with the Government and weak legal structures remain problems. Because of its size and wealth of resources, the long-term potential of Congo (Kinshasa) was more promising, and the country could return to world markets as an important supplier of cobalt, copper, diamond, and zinc. The future prospects for economic development of Congo (Kinshasa) depended on its ability to achieve political and economic stability and to put in place the legal and business framework needed to attract new foreign investment.

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Major Source of Information

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TABLE 1
CONGO (KINSHASA): PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
METALS						
Cobalt:						
Mine output, Co content e/ 3/		2,000	3,500	5,000 r/	6,000 r/	7,000 e/
Metal, Co content 4/		3,540 r/	2,808 r/	4,490 r/	5,180	4,320
Columbium and tantalum, columbite-tantalite concentrate:						
Gross weight e/		NA 5/	NA 5/	NA 5/	NA 5/	450 e/
Nb content e/		NA	NA	NA	NA	130
Ta content e/		NA	NA	NA	NA	130
Copper:						
Mine output:						
By concentration or cementation		6,200	--	--	--	--
Leaching (electrowon)		43,800	39,651	34,994	32,000 r/ e/	21,000 e/
Total		50,000	39,651	34,944	32,000 r/ e/	21,000 e/
Metal:						
Smelter, primary:						
Electrowon (low grade)		43,800	40,000	40,000	32,000 e/	21,000 e/
Other		6,000	--	--	--	--
Total		49,800	40,000	40,000	32,000 e/	21,000 e/
Refinery, primary, electrolytic		40,147	37,658	38,236	31,225	20,500
Gold 6/	kilograms	1,252	394	151	207	52
Silver e/	do.	500	500	--	--	--
Zinc, mine output, Zn content 6/		3,159	1,660	1,147	--	215
INDUSTRIAL MINERALS						
Cement, hydraulic 6/		240,790	124,929	134,324	171,210	96,000
Diamond: 6/ 7/						
Artisanal	thousand carats	15,437	15,558	19,252	15,328	13,200 e/
MIBA 8/	do.	6,803	6,419	6,831	4,788	4,500 e/
Total	do.	22,240	21,977	26,083	20,116	17,700 e/
Lime e/		50,000	50,000	25,000	25,000	25,000
Stone, crushed e/		200,000	200,000	100,000	100,000	100,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous e/		10,000	5,000	5,000	--	--
Petroleum:						
Crude 6/	thousand 42-gallon barrels	10,707	10,146	9,444	8,650	10,300
Refinery products: e/						
Liquefied petroleum gas	do.	1	1	4 r/	4 r/	4
Gasoline	do.	89	89	434 r/	431 r/	431
Kerosene		90	90	340 r/	340 r/	340
Jet fuel	do.	45	45	175 r/	180 r/	180
Distillate fuel oil	do.	90	90	457 r/	460 r/	460
Residual fuel oil	do.	280	280	874 r/	880 r/	880
Refinery fuel and losses 9/	do.	135	135	200 r/	205 r/	205
Total	do.	730	730	2,484 r/	2,500 r/	2,500

e/ Estimated. r/ Revised. -- Zero. NA Not available.

1/ Table includes data available through May 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ Includes mine production and reprocessed tailings.

4/ Salable refined production only; excludes white alloy, matte

5/ Columbite-tantalite concentrates are produced by artisanal miners, but data on production are speculative and unreliable for estimating.

6/ Reported data from Central Bank report: Economic activity-Volume of production-Mining and metallurgical production, August 2000.

7/ An estimated 20% of total diamond production is gem quality.

8/ Société Minière de Bakwanga, 80% owned by Government.

9/ Includes "Other."

THE MINERAL INDUSTRIES OF

CÔTE D'IVOIRE, GUINEA, LIBERIA, AND SIERRA LEONE

By Philip A. Szczesniak

CÔTE D'IVOIRE

Civil unrest that began in December 1999 caused foreign investment to begin to dry up and pushed the economy towards a recession (Washington Post, 2000). Côte d'Ivoire's production of minerals represented a minor component of its national economy, whereas agriculture accounted for 26% of the gross domestic product (GDP) in 1999 (World Bank, September 11, 2000, Côte d'Ivoire at a glance, 1999, accessed November 2, 2000, at URL http://www.worldbank.org/data/countrydata/aag/civ_aag.pdf). The country was one of the world's largest producers of cocoa beans, coffee, and palm oil. Although mineral production was modest, offshore hydrocarbon production remained an important domestic source of energy. Côte d'Ivoire had proven deposits of bauxite, cobalt, diamond, iron, manganese, nickel, and tantalite (Mining Journal, 2000a). A number of companies were actively operating on exploration permits in 2000.

Despite the civil unrest, gold production in 2000 increased to 3,154 kilograms (kg), which exceeded forecasts of 2,880 kg (Gold Gazette, 2000). Most of the gold was produced at two gold mines. The Ity gold mine, which was operated by the Société des Mines d'Ity [Normandy Mining Ltd. of Australia (51%) and the state-owned Société d'Etat pour le Développment Minier (SODEMI) (49%)] produced more than 1,500 kg of gold. The Angovia gold mine, which was purchased on July 31, 2000, from Bureau de Recherches Geologiques et Minières of France by the COGEMA Group of France through its subsidiary Compagnie Francaise de Mines et Metaux, also produced more than 1,500 kg of gold in 2000 (COGEMA, August 9, 2000, COGEMA buys COMINOR, accessed April 11, 2001, at URL http://www.cogema.fr/actualites_gb/communiques/presse_gb/august092000.html).

Eden Roc Mineral Corp. of Canada renewed its exploration permit for the Afema property for an additional 3 years; the Afema exploration permit was jointly owned by Eden Roc Mineral Corp. (85%) and SODEMI (15%). Eden Roc's production of gold from Afema was short-lived because the mine had been deemed unprofitable (Canada News Wire, October 12, 2000, Exploration permit for Afema property renewed and reissued to Eden Roc Mineral Corp., accessed October 13, 2000, at URL http://www.newswire.ca/releases/October2000/12/c2403.html).

The Nielle joint venture of Randgold Resources Ltd. of the United Kingdom and North Ltd. of Australia continued evaluation of the Tongon project. Resource estimates at Tongon were upgraded to 52,876 kilograms per year (reported as 1.7 million ounces per year) of gold (Randgold Resources Ltd., August 1, 2000, Morila on track, decision time for Syama as Randgold Resources Ltd. posts first profit, accessed July 25, 2001, at URL http://www.randgoldresources.com/new_page_1.htm).

Other companies with gold interests in Côte d'Ivoire were Ashanti Goldfields Co. Ltd. of Ghana, Durban Roodepoort Deep Ltd. of South Africa, Equigold NL of Australia, Jandera Resources NL (a subsidiary of Diversified Mineral Resources NL of Australia), and Shield Equities Ltd. of Australia.

Although kimberlites were known to exist at Kanangone, Seguela, and Tortiya, diamond was produced only from the alluvial deposits at Tortiya and Seguela. Carnegie Minerals Ivory Coast S.A.R.L. (CMIC) explored the Bobi concession, which included the Toubaboukou dyke. CMIC was a joint venture of African Carnegie Diamonds plc (75%), which was a subsidiary of Carnegie Corp. Ltd. of Australia (formerly Carnegie Minerals NL), and SODEMI (25%). The Government would acquire 10% interest in the venture from Carnegie Corp. Ltd. at the mining stage. Absolute Resources Corp. of Canada announced the sale of their diamond interests to Tanqueray Resources Ltd. of Canada.

Iron ore deposits in Côte d'Ivoire were at Monogaga, Mount Gao, Mount Klahoyo, Mount Nimba, Mount Segaye, Mount Tia, and Mount Tortro (Mines98, 1998, Ivory Coast country profile, accessed November 8, 2001, at URL http://www.mines98.com/country/ci/3.htm). The country's total iron ore resource was estimated to be 3,000 million metric tons (Mt) (MBendi Information Services (Pty.) Ltd., July 12, 2000, Côte d'Ivoire—Iron ore mining, accessed February 19, 2001, at URL http://www.mbendi.co.za/indy/ming/iron/af/ci/p0005.htm). In December 1999, Melkior Resources, Inc. of Canada signed a letter of agreement with SODEMI to earn a 50% interest in the Mount Klahoyo iron deposit; SODEMI would retain 50% equity interest in the prospect (Melkior Resources, Inc., December 16, 1999, Melkior lands a major iron project in Ivory Coast, accessed December 17, 1999, at URL http://biz.yahoo.com/ccn/991216/m.html).

Falconbridge Ltd. of Canada continued evaluation of its Touba-Biankouma license. The property contains a deposit of nickel and cobalt that was estimated to be 292 Mt of ore at a grade of 1.46% nickel and 0.11% cobalt. In 1999, a feasibility study was carried out by Falconbridge Ltd.'s (60%) joint venture with SODEMI (25%) and Consolidated Trillion Resources Ltd. of Canada (15%) (MBendi Information Services (Pty.) Ltd., [undated], Côte d'Ivoire—Nickel and cobalt mining, accessed February 10, 2001, at URL http://www.mbendi.co.za/indy/ming/nkcb/af/ci/p0005.htm).

Although Ocean Energy, Inc. of the United States abandoned the East Grand Lahou well in October 1999, it continued to produce oil from the Lion Field and gas from the Panthere Field and had several development projects at the Eland, the Ibex, and the Kudu fields (Ocean Energy, Inc., 2000, Côte d'Ivoire news, accessed November 8, 2001, at URL http://www.oceanenergy.com/3ep/internat_cote1.html).

The operating company for the Foxtrot gasfield on offshore Bock CI-27 was Apache Côte d'Ivoire Petroleum. After Apache Corp. of the United States sold its stake in the Apache Côte d'Ivoire Petroleum venture in September 1999 to Mondoil Corp. of the United States, the new owners were state-owned La Société Nationale d'Operations Pétroliéres de la Côte d'Ivoire (40%), Mondoil Côte d'Ivoire (24%), SAUR Energies Côte d'Ivoire (24%) (a subsidiary of SAUR International of France), and the Electricité de France/Gaz de France Group (12%) (Africa Energy and Mining, 1999).

Among the other companies with oil and gas interests in Côte d'Ivoire were Dana Petroleum plc of the United Kingdom, Ranger Oil Ltd. of Canada, Tullow Oil plc of the United Kingdom, and Vanco Energy Co. of the United States.

The Government announced its intention to privatize 26 state-owned companies by the end of 2000. Among them was Côte d'Ivoire's oil refinery Société Ivoirienne de Raffinage (SIR). The Government planned to sell 37% of its 47.25% holding in SIR. The Government of Burkina Faso owned 5.39% equity interest in SIR, and the remainder was held by subsidiaries of the Elf Aquitane Group of France, Exxon Mobil Corporation of the United States, the Royal Dutch/Shell Group of the Netherlands and the United Kingdom, Texaco, Inc. of the United States, and the TotalFina Elf Group of France. SIR had a refining capacity of 3 million metric tons per year (Mt/yr) and mainly refined crude oil from Nigeria (Alexander's Gas and Oil Connections, September 14, 1999, Ivory Coast extends preliminary round of bids for stake in SIR refinery, accessed September 16, 2000, at URL http://www.gasandoil.com/goc/history/welcome.html). The December 24, 1999, military coup d'état resulted in the indefinite postponement of the SIR privatization (Africa Energy and Mining, 2000a).

GUINEA

Guinea was the world's second largest bauxite producer and had the world's largest bauxite resources (Plunkert, 2001a). In 1999 (the latest year for which data are available), mining accounted for about 16% of the nation's estimated $3.7 billion GDP and a major portion of the value of Guinea's exports (World Bank, September 9, 2000, Guinea at a glance, accessed November 22, 2000, at URL http://www.worldbank.org/data/countrydata/aag/gin_aag.pdf). Guinea supplied about 39% of the United States' metallurgical-grade bauxite imports in 2000 (Plunkert, 2001b). In addition to possessing significant bauxite reserves, Guinea has diamond, gold, granite, and iron deposits. The Government encouraged the foreign participation in the bauxite sector and promoted the diversification of the mineral industry.

The Mining Code of 1995, as amended by Arrêté no. A98/5874/MRNE/SGG of August 10, 1998, defines incentives, mineral ownership, mining fees, mining titles, royalties, and other taxes. The Government reserves 15% free equity for itself in all gold and gem operations. State participation in bauxite- and iron-ore-mining ventures is subject to negotiation. Mineral beneficiation in Guinea is encouraged. Royalties are 5% on alumina and 3.5% on concentrates of other minerals compared with 10% on bauxite and 7% on other ores. The corporate income tax rate was 35%.

The largest bauxite producer in Guinea Compagnie des Bauxites de Guinée (CBG) operated a number of open pit bauxite mines, which included the Sangarédi, in the Boké District. CBG had a capacity of 14 Mt/yr and was controlled by Halco Mining, Inc. (51%) (a consortium comprised of Alcan, Inc. of Canada, Pechiney of France, and Alcoa, Inc. of the United States), and the Government (49%) (Mbendi Information Services, May 16, 2001, Guinea—Bauxite mining, accessed November 8, 2001, at URL http://www.mbendi.co.za/indy/ming/baux/af/gu/p0005.htm).

In 2000, Reynolds Metals Co. of the United States and the Guinean Government were negotiating for the sale of 100% of the Government's stake in the Fria bauxite mine and the Kimbo alumina refinery. Reynolds Metals Co. offered to modernize the Kimbo alumina plant, which had a capacity of 650,000 metric tons per year (t/yr). Russia's Sibirsky Aluminy Group was also interested in the mine and refinery (Metal Bulletin, 2000a).

The State Bauxite Company of Guinea signed an agreement with Sibirsky Aluminy Group to supply bauxite to Sibirsky Aluminy Group's alumina plant in Russia in exchange for mining equipment (Metal Bulletin, 2000c). Also, United Arab Emirates Offset Group secured a bauxite concession in Guinea and was discussing the acquisition of technology for a 250,000-t/yr smelter with Pechiney (Metal Bulletin, 2000b).

In 2000, Guinea Aluminum Products Corp. of the United States signed a memorandum of understanding with the Guinean Government for the construction and operation of an alumina refinery. The facility would involve investment of $1.5 billion with an operating capacity of 240,000 t/yr (Boubah.Com, December 2000, Interview with GAPCO's director on new Guinea project, accessed August 3, 2001, at URL http://www.boubah.com/Guineenews/Interview/ Interview.htm).

In December, the Government awarded Semafo, Inc. of Canada a 10-year mining license for the Jean Gobele project. Construction was expected to begin in early 2001 with production of 18,662 kg/yr (reported as 600,000 ounces per year) of gold expected to begin by the end of 2001. Costs of operations were estimated to be $157 per ounce of gold (Semafo, Inc., [undated], Guinea operations, accessed July 11, 2001, at URL http://www.semafo.com/operations_guinea.html).

Kenor ASA of Norway was the operator of the Siguiri gold mine, which was the largest in Guinea, and discovered significant gold mineralization at its Kankarta prospect. Kenor ASA noted that the property is located in a region that had not been subjected to previous drilling activity (Mining Journal, 2001). Other companies with gold interests in Guinea were African Mining Corp. of Canada, Arena Gold Resources, Inc., of Canada, Cambior, Inc., of Canada, Mano River Resources, Inc., of Canada, Mincor Resources NL of Australia, Rio Tinto plc of the United Kingdom, and Shield Equities Ltd.

The Government forecast for diamond production in 2000 was 60,000 carats; the potential for an additional 220,000 carats could come from small-scale operators (Africa Energy and Mining, 2000b). Trivalence Mining Corp. of Canada was the largest producer with diamond production of 40,803 carats at its Aredor diamond concession. Trivalence estimated that production from Aredor at the current (2000) level could continue for an additional 10 years (Trivalence Mining Corp., 2000, Overview of operations at Aredor diamond mine in Republic of Guinea, accessed August 6, 2001, at URL http://www.trivalence.com/guinea_operations.htm). Other companies with diamond interests in Guinea were Arena Gold Resources, Inc., Dia Bras Exploration, Inc. of Canada, Hymex Diamond Corp. of Canada, Kenor, Rio Tinto, and Searchgold Resources, Inc. of Canada.

Total bauxite reserves were estimated to be about 20 billion metric tons (Gt) at a grade of more than 40% aluminum oxide, according to the Ministère des Ressources Naturelles et de l'Energie (1997). Iron resources were estimated to be about 6 Gt at a grade of 64% to 68% iron, and gold reserves were estimated to be between 200 and 1,000 metric tons (t) of contained gold. The Government also estimated there were reserves of 20 million carats of diamond in Guinea.

Major highways have been paved, but the rural transportation infrastructure was inadequate to meet needs. Guinea had two main ports—Conakry and Kamsar. Conakry, which was the country's main general cargo port, was linked to the Kinda Mine by a 104-kilometer (km) 1.435-meter (m) standard-gauge railroad line and to the Fria Mine by a 145-km 1-m narrow-gauge railway. Kamsar, which handled only bauxite shipments, was linked to the Sangarédi Mine by a 135-km standard-gauge railroad line. In addition to the mine railroads, a 661-km 1-m narrow-gauge line connected Conakry with Kankan.

Although the 1995 mining code significantly improved the business climate for the mineral industry, mining operations remained hampered by infrastructural constraints. International funding of mineral deposit development was proceeding more slowly than anticipated. The less-than-expected foreign investment was attributed to the country's perceived political and economic risks and decreased availability of financing for junior mining companies, as well as civil disturbances in the adjacent countries of Guinea-Bissau, Senegal, and Sierra Leone.

Alumina, bauxite, and gold production are expected to continue to dominate Guinea's economic activity. Ventures requiring significant electric power availability, such as an aluminum smelter, could become feasible as the nation's power-generation capacity is increased.

LIBERIA

Mineral production in Liberia consisted mainly of artisanal recovery of diamond and gold. The Government encouraged investment in natural resource development, although formal economic activity has been slow to recover since the end of the civil war in 1997. International exploration increased in 2000 as companies came to Liberia to examine what has been described as one of the last areas of virtually unexplored rocks in the world. Eastern Liberia is made up of rocks of Birimian age with significant potential for gold. Western Liberia is made up of rocks of Archean age that contain diamond, gold, iron ore, nickel, manganese, palladium, platinum, and uranium (Mining Journal, 2000b; Mines98, 1998, Liberia country profile, accessed November 8, 2001, at URL http://www.mines98.com/country/lr/3.htm).

In December, Mano River Resources, Inc., announced the discovery of a kimberlite pipe in western Liberia only 6 months after beginning its exploration program in mid-2000. The company's president expected that additional kimberlite pipes would be discovered and that there was a reasonable basis to expect some of them to be diamondiferous (Mano River Resources, Inc., 2000b). Also in December 2000, a United Nations panel called for an embargo on all diamond exports from Liberia owing to concerns of their potential involvement in civil unrest in Sierra Leone, their neighbor to the northwest. This action by the United Nations followed previous bans on diamond exports from Angola and Sierra Leone (Associated Press, December 19, 2000, Embargo on Liberian diamonds pursued, accessed December 30, 2000, at URL http://dailynews.yahoo.com/h/ap/20001219/wl/un_conflict_diamonds_1.html).

Mano River Resources, Inc., made several announcements of gold discoveries in 2000. In May, Mano River, announced that drilling had intersected gold mineralization at its Gondoja property (Mining Journal, 2000c). In July, Mano River announced discoveries of gold on its Weaju and King George Larjor properties, both of which are located in western Liberia. Resources at Weaju were estimated to be around 660,000 t at a grade of 10.9 grams per ton (g/t) gold (233,000 ounces of contained gold), and those at King George Larjor were estimated to be 4.1 Mt at a grade of 4.6 g/t gold (610,000 ounces of contained gold) (Mano River Resources, Inc., 2000a, 2000c). Other companies with gold interests in Liberia in 2000 were Freedom Gold Ltd. of the United States and Haddington International Resources Ltd. of Australia.

SIERRA LEONE

Mineral production in Sierra Leone in 2000 consisted mainly of artisanal recovery of diamond and gold. Civil strife has adversely affected investment in natural resource development since 1995, although conditions could improve with the implementation of the July 1999 peace agreement.

In 1999, the Sierra Leonean Parliament enacted an amendment to the 1994 Mines and Minerals Act that introduced three new sections. These were a procedure for sale and export of precious minerals by licence holders, penalties for unlawful possession of precious minerals, and penalties for smuggling precious minerals from Sierra Leone (Mining Journal, 2000d).

In November 2000, Sierra Leone's President announced that he hoped that Sierra Rutile Ltd. (owned 100% by MIL Investments SA of Luxembourg by mid-2001) would be producing sometime in 2002. Sierra Rutile had operated the largest and highest grade resource of rutile in the world prior to its closing in 1995. Furthermore, he pledged to assist in any financing needed to restart operations. Nord Resources Corp. of the United States, which sold its 50% share in Sierra Rutile Ltd. in 1999, had expected capital expenditures of more than $100 million were needed to restart operations (Industrial Minerals, 2001).

Alusuisse Group of Switzerland, which was the owner of the

Sieromco bauxite mine, announced that after reassessing the mine, it had decided not to return to Sierra Leone and was looking for a buyer of its operation (Mining Journal, 2000d; Economist Intelligence Unit, October 20, 2000, Sierra Leone economic background, accessed June 6, 2001, at URL http://www.eiu.com/latest/433013.asp).

Olympus Stone, Inc., of Canada entered into an agreement to acquire the Black Pearl granite mine at Adonkia, Freetown. The mine had a production capacity of 300 cubic meters per month of dimension stone. Management estimated that $437,000 would be required to restart operations (Canada Newswire, April 10, 2000, Olympus announces Black Granite mine acquisition, accessed July 24, 2001, at URL http://www1.newswire.ca/releases/April2000/10/c2676.html).

In a joint venture with the Ministry of Mineral Resources of Sierra Leone, TGS-NOPEC Geophysical Co. of the United States began a two-dimensional seismic survey that will cover 2,500 km in Sierra Leone's portion of the Liberia offshore basin (Africa Energy and Mining, 2000c).

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TABLE 1
CÔTE D'IVOIRE, GUINEA, LIBERIA, AND SIERRA LEONE: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity	1996	1997	1998	1999	2000
CÔTE D'IVOIRE 3/					
Cement	1,000	1,100	650	650	650
Columbite kilograms	NA	NA	NA	273 r/ 4/	137 4/
Diamond carats	301,591 4/	306,665 4/	310,000	398,282 r/ 4/	320,207 4/
Gold kilograms	1,883 4/	2,419 4/	3,400	2,717 r/ 4/	3,154 4/
Natural gas million cubic meters	547 4/	879	1,000	800	800
Petroleum:					
Crude thousand 42-gallon barrels	5,833 4/	5,334 4/	7,300	10,000	10,000
Refinery products do.	7,620 4/	7,850 4/	7,500	10,000	10,000
Tantalite kilograms	500	1,350 4/	1,400	686 r/ 4/	408 4/
GUINEA 5/					
Alumina:					
Production:					
Hydrate	650	527	490	500	550
Calcined	640	650 4/	480	500	500
Shipments, calcined	619	640	511 4/	480 4/	480
Bauxite:					
Mine production:					
Wet basis 6/	18,700	19,250	17,000	17,000	17,000
Dry basis 7/	15,628	16,359 4/	15,000	15,000	15,000
Calcined	470	660	100	100	100
Shipments (dry basis):					
Metallurgical	13,000	14,500	14,000	14,000	14,000
Calcined	95	95	100	100	100
Cement	260,000	260,000	260,000	250,000	250,000
Diamond 8/ 9/ thousand carats	205	205	400	550 r/	450
Gold 9/ kilograms	6,838	7,100	11,700	13,300	13,300
Salt	NA	NA	NA	15	15
LIBERIA 10/					
Cement, hydraulic 11/	15	7	10	15	15
Diamond carats	150,000	200,000	300,000	200,000 r/	170,000
Gold kilograms	700	500	800	1,000	1,000
SIERRA LEONE					
Cement 12/	160	50	100	100	100
Diamond thousand carats	270	400	250	600	350
Gold kilograms	16	20	15	30	30
Gypsum	5	2	4	4	4
Salt	50	10	1	1	1

r/ Revised. NA Not available.

1/ Table includes data available through July 26, 2001.

2/ Estimated data are rounded to no more than three significant digits.

3/ In addition to the commodities listed, Côte d'Ivoire produced clays, crushed granite, manganese, sand and gravel, and stone; but information is inadequate to make estimates of output levels.

4/ Reported figure.

5/ In addition to the commodities listed, Guinea produced modest quantities of crude construction materials (clays, sand and gravel, and stone); but information is inadequate to make reliable estimates of output levels.

6/ Metallurgical plus calcinable ore estimated to be 13% water.

7/ Data are for wet-basis ore estimated to be 13% water, reduced to dry basis estimated to be 3% water.

8/ Production is approximately 70% to 80% gem quality.

9/ Figures include artisanal production.

10/ In addition to the commodities listed, Liberia produced a variety of industrial minerals and construction materials (clays, gypsum, sand and gravel, and stone); but information is inadequate to make reliable estimates of output levels.

11/ Cement production from Liberian Cement Corporation had been reported as zero from 1996 to 1997 because of the civil war. The Scancem AB 1997 annual report indicates the cement plant was open during most of the civil war.

12/ Production from imported cement clinker.

THE MINERAL INDUSTRIES OF

DJIBOUTI, ERITREA, ETHIOPIA, AND SOMALIA

By Thomas R. Yager

DJIBOUTI

In recent years, Djibouti, which is a small east African country, has been known to occasionally produce small quantities of clays, granite, limestone, marble, salt, and sand and gravel. Other mineral occurrences of potential economic interest included diatomite, geothermal fluids and mineral salts, gold, gypsum, perlite, petroleum, and pumice.

In 1999, Djibouti's gross domestic product (GDP) amounted to about $550 million at purchasing power parity, which was an increase of about 2% compared with that of 1998. The per capita income at purchasing power parity was $1,200 in 1999. Industry accounted for about 20% of the GDP (U.S. Central Intelligence Agency, 2000a).

Lake Assal is the source for the country's production of mineral salts. Other minerals found in the Lake Assal area include diatomite (near Hanle, at Karkerou, and near Tikible) and gypsum. The Ali Sabieh region is the source of Djibouti's clay, limestone, and pumice deposits (Indian Ocean Newsletter, 1993). Perlite deposits in the volcanic region of Egerleta were estimated to have resources of at least 48 million metric tons (Mt) (U.S. Embassy, Djibouti, Djibouti, 1995).

In 2000, the Government of Djibouti announced its intention to contribute 20% of the cost for a new cement plant; a private foreign investor would cover the remaining 80% (Bouh and Haid, 2000, p. 9). In 2000, Djibouti imported all its cement. The International Cement Review (2001a) estimated that the country's cement consumption was 70,000 metric tons (t) in 2000.

Numerous geothermal areas are found in Djibouti. Exploration work has taken place in the Lake Abbe area on the border between Djibouti and Ethiopia, the Arta area north of the Arta Mountains, the Assal area between Lake Assal and Tadjura Bay, the Gaggade Plain, and the Hanle Plain near Yoboki. Other geothermal areas include the Dorra, the Obock, and the Tadjura areas (Jonsson, 1985).

In 1998, Djibouti consumed about 4.1 million barrels (Mbbl) of petroleum products. The country produced 177 gigawatt-hours (GWh) of electricity, which was generated at diesel-fired plants (U.S. Central Intelligence Agency, 2000a). A joint venture between Geothermal Development Associates of Nevada and Electricité de Djibouti will create a 30-megawatt (MW) geothermal plant to exploit geothermal fluids near Assal (U.S. Department of State, October 25, 2000, Sustainable development projects approved for Africa, Latin America, accessed March 26, 2001, at URL http://www.usinfo.state.gov/regional/af/trade/10102604.htm).

Djibouti's transportation network comprised about 2,900 kilometers (km) of roads, of which nearly 400 km was paved. Ethio-Djibouti Railway Co. (jointly owned by Djibouti and Ethiopia) planned to rehabilitate the railway between Djibouti and Addis Ababa. This project received financial support from the European Union and the World Bank; completion was expected in 2004. In June 2000, the Dubai Ports Authority won the contract to manage Djibouti Port on the Red Sea for 20 years; it planned to more than double the port's handling capacity (MBendi Information Services, 2000, Djibouti—Oil and gas industry—Overview, accessed January 8, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/dj/p0005.htm).

The outlook for Djibouti's mineral industry is favorable, although growth will be constrained by small domestic markets and modest natural resources.

ERITREA

In recent years, the east African country of Eritrea produced a variety of minerals, rocks, and semimanufactured goods, which included basalt, cement, common clay, kaolin, coral, gold, granite, gravel, gypsum, lime, limestone, marble, pumice, quartz, salt, sand, and silica sand (table 1). The country also produced refined petroleum products. Eritrea exported and transshipped minerals to landlocked Ethiopia.

The war between Eritrea and Ethiopia continued until June 18, when the two countries signed a cessation of hostilities agreement and agreed to return to peace talks. The war took a heavy toll upon the Eritrean economy; the World Bank (2000a, p. 5) estimated that war damage amounted to 90% of the 1999 GDP. Other damage included the loss of port revenues, which declined by two-thirds owing to the loss of transshipment trade with Ethiopia. The loss of trade with Ethiopia also caused exports to decline by 63%. In October 2000, the World Bank (2000a, p. 5-6) predicted that GDP for 2000 would be down by 9.5%.

In 1999, Eritrea's GDP amounted to about $2.9 billion at purchasing power parity. The per capita income at purchasing power parity was $750 in 1999 (U.S. Central Intelligence Agency, 2000b). The International Monetary Fund (2000, p. 24) estimated that manufacturing accounted for 8% of GDP in 1999; construction, 9%; and mining and quarrying, less than 1%.

The war with Ethiopia has discouraged growth in the Eritrean minerals sector. Although artisanal gold production continued in the areas south and southwest of Asmara, plans for commercial levels of gold production had to be put on hold. The war forced Nevsun Resources Ltd. to suspend operations on its gold exploration projects. Tan Range Exploration Corp. of Canada abandoned the Asmat, the Erota, and the Melebesc concessions. The Augaro gold property in western Eritrea [owned by Anglo American Prospecting Services (Proprietary) Ltd. of South Africa and Rift Resources Ltd. of Canada] was overrun by Ethiopian military forces (Rift Resources Ltd., 2000). The war also forced Rift Resources to suspend work on the Adi Nefas project.

Eritrea has considerable resources of copper, gold, and zinc at Adi Nefas. The Adi Nefas Doop gold deposit was estimated to have resources of 2.9 Mt at a grade of 3.1 grams per ton (g/t) gold. The Adi Nefas polymetallic massive sulfide deposit was estimated to have a resource of 1.4 Mt at a grade of 9.3% zinc, 0.95% copper, 3.28 g/t gold, and 129 g/t silver (Maiden Gold NL, 2000, Eritrean base metals deal signed with Phelps Dodge, accessed March 30, 2001, at URL http://www.maiden.com.au/files/qrtsep00.html).

Other significant deposits of copper, gold, and zinc included Adi Rassi, Debarwa, and Emba Derho. In late 2000, Australia's Maiden Gold NL and Hong Kong's Africa Wide Resources Ltd. signed an agreement with Phelps Dodge Corp. for the acquisition of an 80% stake in the Debarwa and the Medrizien (which included Emba Derho) exploration licenses and other deposits west of Asmara (Africa Mining Intelligence, 2001). As part payment for the Eritrean properties, Phelps Dodge will receive 4 million shares of Maiden's stock. Phelps Dodge has identified resources of 1.65 Mt of ore at a grade of 5.1% copper and 1.4 g/t gold at Debarwa. It also indicated that probable additional resources at Debarwa amount to 1.3 Mt and contain zinc and silver, as well as gold and copper. The Emba Derho deposit has resources of 2.5 Mt at a grade of 2.36% zinc (Africa Mining Intelligence, 2000).

Eritrea also has deposits of chromium, iron, lead, magnesium, and nickel. Garnierite-chromite-magnesite-asbestos deposits that contain nickel are known to occur in northern Eritrea near the Shamege River. Large iron deposits are known to exist in several areas of the country—Agametta-Sabub, the Eritrean highlands, Ghedem (iron-manganese), Mount Tullului, Taereshi, and Woki Defere (Eritrean Ministry of Energy and Mines, 1997, p. 7).

The World Bank (1994, p. 43) indicated that Eritrea has resources of barite, feldspar, and kaolin. Deposits of barite were found in Debarwa, Gharsa Wadis, Heneb, Ketina, and Meter. Barite veins also occur associated with the faults in the sediments of the Dogali and the Desset series. The World Bank estimated Eritrea's resources of barite to be 1.4 Mt. High-quality feldspars occur at Shiliki; the country's total feldspar resources were estimated to be 200,000 t. Large kaolin deposits occur in the lateritic areas of Adi Abeito, Adi Ahderhom, Adi Hausera, Adi Kaieh, Teramni, and Zegrib. Eritrea's total resources of kaolin were estimated to be 2.5 Mt (Eritrean Ministry of Energy and Mines, 1997, p. 7). From 1996 to 2000, Eritrea's production of kaolin averaged about 3,000 metric tons per year (t/yr) (table 1).

Other industrial mineral deposits include gypsum, potash, salt, sand, silica sand, and sylvite. Gyspum-bearing evaporates, potash, and sylvite occur at Colluli. Large deposits of common salt occur in the Dahlak Archipelago and at several places along the Red Sea coast (Eritrean Ministry of Energy and Mines, 1997, p. 7).

Eritrea has exploited its resources of construction materials for domestic and export markets. Europe, the Far East, and the Middle East have imported finished or semifinished Eritrean granite and marble. Large deposits of marble occur at Amberbeb, Debri, Gogne, Kertsekomte, and Mount Kuruku. Granites of various colors and textures outcrop over large areas in Eritrea. Limestone deposits were found in the southern part of the country near Adi Kaieh and Arberebu (Eritrean Ministry of Energy and Mines, 1997, p. 7).

In 1998, Eritrea consumed about 2.9 Mbbl of petroleum products (U.S. Energy Information Administration, 2001, Country energy balance—Eritrea, accessed June 20, 2001, at URL http://www.eia.doe.gov/emeu/world/country/cntry_ER.html). In 1997, the Assab refinery (jointly operated with Ethiopian Petroleum Co.) shut down owing to high production costs. Eritrea produced 178 GWh of electricity, which was generated at diesel-fired plants (U.S. Central Intelligence Agency, 2000b). The Alid volcanic center was being explored as a source for geothermal energy.

The World Bank and other international donors approved a $25 million loan for repairing war damage to Eritrea's energy sector facilities. Funds will be spent on rehabilitating Massawa Hirgigo, which was the country's largest powerplant, and replacing generators and electrical power systems in other parts of the country (World Bank, 2000b, p. 13).

Eritrea's transportation network comprised about 4,000 km of roads, of which nearly 900 km was paved. The railway linking Ak'ordat and Asmara with the port of Massawa was 317 km; only a 5-km stretch in Massawa was operational. Rehabilitation of the remainder was underway. Ports and harbors were Assab and Massawa. In October 2000, the World Bank and others approved a $36 million loan for repairs of Eritrea's roads and bridges (World Bank, 2000b, p. 13).

The outlook for Eritrea's mineral industry is for gradual recovery from the war. Improvements in the general economic situation and the need to rebuild infrastructure are likely to increase demand for building materials. Further development (especially in the metals sector) depends upon favorable conditions on the world minerals markets and the success of the peace process, infrastructure rehabilitation, and landmine clearing in rural areas.

ETHIOPIA

Ethiopia has been a producer of minerals, rocks, and such semimanufactured goods as brick clay, cement, diatomite, feldspar, gold, gypsum and anhydrite, kaolin, lime, pumice, salt, scoria, soda ash, sand, stone, and tantalite (table 1). Refined petroleum products were also produced until 1997. Ethiopia's main mineral export was gold. Prior to the war with Eritrea, most of Ethiopia's exports were shipped through the Eritrean ports of Assab and Massawa. Hostilities between the two countries forced Ethiopia to use the port of Djibouti as a substitute.

The war caused substantial damage to the country's roads, bridges, and power supply (World Bank, 2000c, p. 4). The war also discouraged foreign investment in Ethiopia, diverted scarce financial resources to military expenditures, and had serious effects upon economic growth.

In 1999, Ethiopia's GDP amounted to about $33.3 billion at purchasing power parity, which was unchanged compared with that of 1998. Per capita income at purchasing power parity was $560 in 1999 (U.S. Central Intelligence Agency, 2000c). The International Monetary Fund (1999, p. 65) estimated that manufacturing accounted for 5% of GDP in 1998; construction, 3%; and mining and quarrying, less than 1%.

In spite of the loss of economic growth and foreign investment, developments in the minerals sector were numerous in 2000. In January, the Government privatized Ethiopian

Mineral Development Share Co., which prospected, explored, evaluated, and developed mineral deposits other than petroleum, natural gas, and geothermal energy (Addis Tribune, January 28, 2000, Two companies privatized, accessed June 30, 2000, at URL http://www.addistribune.com/Archives/2000/01/28-01-00/Two.htm).

In May, Etno Mining plc was formed as a joint venture of the Norwegian company Norex Mining and Energy (75%) and the Ethiopian companies Geodev plc. (12.5%) and Afreds (12.5%). The new company will mine precious minerals, such as diamond, gold, platinum, and silver (Indian Ocean Newsletter, 2000).

Gold was produced at the Lega Dembi Mine (owned by Midroc-Ethiopia plc); the mine is in the southern part of the country. Resources from this mine were estimated to be 62 t of metal from ore that grades 4 g/t gold. Other mines under development included the Adola and the Sakara with estimated gold resources of 13 t and 3 t, respectively. Prospecting and exploration work was continuing at numerous deposits, such as the Akobo, the Chamuk, the Sirkole, and the Degero, where resources were estimated to be 3.6 t, 0.7 t, 0.7 t, and 0.07 t, respectively (Selassie and Reimold, 2000, p. 28-29). In 2000, gold was the mineral commodity that made the largest contribution to the Ethiopian economy; the value of gold produced exceeded $33.18 million (Getachew Tesfaye, Ethiopia Ministry of Mines and Energy, written comm., 2001).

Ethiopia has notable resources of tantalum. The Kenticha deposit is the source of Ethiopia's tantalum oxide concentrates; in May 2000, Midroc-Ethiopia bought the state-owned Kenticha mining enterprises. The Meleka deposit of columbium (niobium) and tantalum was undergoing follow-up exploration (Selassie and Reimold, 2000, p. 29). In 2000, the value of tantalite produced amounted to $5.7 million (Getachew Tesfaye, Ethiopia Ministry of Mines and Energy, written comm., 2001).

Other metal deposits include copper, iron, manganese, molybdenum, nickel, platinum, and zinc. The Kata copper deposit in western Ethiopia was estimated to have a resource of 10 Mt of ore; further drilling is necessary to determine the grade. Other copper deposits explored were Abatselo and Azale Akendeyu; the latter deposit also may have a high grade of zinc. Of the four iron deposits in the western part of the country, Bikilal is by far the largest and had an estimated resource of 58 Mt of ore that graded 41% iron. The Chago, the Gordana, and the Koree deposits had higher grades (57% to 71.6%) but were much smaller (at most 489,000 t combined). The Melka Arba iron deposit in the southeast had 10.1 Mt of ore that graded 45.6% iron. In southern Ethiopia, the Adola nickel deposit had an estimated resource of 17 Mt of ore that graded 1.38% nickel. The abandoned manganese mine at Enkafela had an estimated resource of 5,000 t of metal from ore that graded 51.26%. Relatively little is known about the Fakusho molybdenum deposit. The resources of the closed platinum mine at Yubdo were estimated to be 12.5 t of metal from ore that graded 0.336 g/t platinum (Selassie and Reimold, 2000, p. 26-27, 29).

Deposits of raw materials for construction are known to exist in Ethiopia. Clays used to manufacture bricks, cement, pipes, and tiles occur in numerous places, such as Awzeit, Debre Tabor, Kerker, Mulo, and Zega Wedem. Proven and probable resources of dolomite at Galletti are 1.43 Mt. Resources of granite have been estimated to be 5.3 Mt and 1.32 Mt at Hasegie and Sakul, respectively. Possible resources of gypsum at Sodoble have been estimated to be 56 Mt, and probable resources at Adigudom are 0.4 Mt. Gypsum was mainly used for cement and stucco production. Proven and provable resources of limestone amount to 69.5 Mt at Mossobo, 50 Mt at Mugher, and 46 Mt at Dire Diwa. All these deposits have been exploited for use in the cement industry. Possible resources of marble were estimated to be 46.5 Mt at Mora, 13.6 Mt at Baruda, and 2.8 Mt at Dalleti. The Mora and Baruda deposits have been exploited for construction projects; raw materials were processed by Ethiopian Marble Industries. Deposits of pumice occur at the Gari Baldi pass and Kimbibit; pumice was used to manufacture cement. Substantial quantities of sand and gravel occur in northern and central Ethiopia; deposits include the Awash Basin (Mengitsu and Fentaw, 2000). In 2000, the value of raw materials for construction produced in Ethiopia amounted to $8.37 million, including $3.97 million for gravel and crushed rock, $2.8 million for limestone, and $551,000 for marble Getachew Tesfaye, Ethiopia Ministry of Mines and Energy, written comm., 2001).

In 2000, Ethiopia produced 879,962 t of cement, which was an increase of about 37.9% compared with that of 1999 (table 1). The Mugher Cement Factory has accounted for most of Ethiopia's cement production in recent years. In 2000, however, a new plant was completed at Mekele with a capacity of 600,000 t/yr (International Cement Review, 2001b). The value of cement produced in 2000 amounted to $19.07 million (Getachew Tesfaye, Ethiopia Ministry of Mines and Energy, written comm., 2001).

The Ministry of Mines and Energy estimated that Ethiopia had resources of 4.3 billion metric tons (Gt) of salt. In late 1999, a salt producers' association was established to exploit salt found at Afdera Wereda for industrial and individual consumption. The association has indicated that it will attempt to sell salt locally and for export (Addis Tribune, October 22, 1999, More than 4 Gt of salt found in Ethiopia, the Ethiopian Salt Producers Association established, accessed June 30, 2000, at URL http://www.addistribune.com/Archives/1999/10/22-10-99/More.htm). Before the war, Ethiopia imported most of its salt from Eritrea. Most salt imports since then have been from Djibouti, India, and Yemen. The value of salt produced in Ethiopia amounted to about $6.84 million in 2000 (Getachew Tesfaye, Ethiopia Ministry of Mines and Energy, written comm., 2001).

The deposits of silica sand at Mugher have proven and probable resources of 3.4 Mt; other deposits occur at Enticho. The Addis Ababa Bottle and Glass Factory has used sands from the Mugher deposit (Mengitsu and Fentaw, 2000). In December 2000, the Ethiopian Investment Authority licensed Summit Glass Works Private Ltd. Co. to build the country's first privately owned plant for the production of glasses, bottles, and related materials. Summit Glass Works was a $46 million joint venture between U.S.-based Summit Partners Ethiopia and a German company. It will mine the raw materials required to produce glass and export its products to neighboring countries.

Other industrial minerals known to occur in Ethiopia include apatite, bentonite, diatomite, feldspar, kaolin, potash, quartz, soda ash, and talc. The Bikilal apatite deposit had possible resources that were estimated to be 127 Mt at a grade of 3.6% phosphorus pentoxide. The possible resources of the Gewane-Mille bentonite deposit were estimated to be 70 Mt. Proven, probable, and possible diatomite resources at Lake Region were estimated to be 85 Mt. The proven, probable, and possible resources of the Dallol potash deposit were estimated to be

160.4 Mt at a grade of 31% to 33.9% potassium chloride (KCl). Proven and probable KCl content amounted to 21.52 Mt (Mengitsu and Fentaw, 2000).

Deposits of coal and natural gas are known to exist in Ethiopia. Lignite coal resources from three different areas in Ethiopia were estimated to be 61 Mt. Additional deposits have been discovered in the western part of the country (Mbendi Information Services, 2000, Ethiopia—Mining—Overview, accessed January 8, 2001, at URL http://www.mbendi.co.za/indy/ming/af/et/p0005.htm). Natural gas resources in the Kalub wet gas field in Ogaden are believed to be 100 billion cubic meters. In December 1999, Secor International, Inc., won the contract to develop these resources; the goal is to produce 500 million cubic meters per year and extract 65,000 t/yr of liquefied petroleum gas and motor fuel (Africa Energy & Mining, 1999).

In 1998, Ethiopia consumed about 6.41 Mbbl of petroleum products. The closure of the Assab refinery rendered Ethiopia totally dependent upon imports to meet its demand for petroleum. In April, a memorandum of understanding for oil prospecting was signed between Kalub Gas Share Co. and Secor. The purpose of the agreement was to strengthen oil-prospecting activities in the Kalub and the Lalla areas (Addis Tribune, April 7, 2000, A memorandum of understanding for oil prospecting signed between two companies, accessed June 30, 2000, at URL http://www.addistribune.com/Archives/2000/04/07-04-00/Memo.htm).

In 1998, Ethiopia produced 1,265 GWh of electricity, most of which was provided by hydroelectric power sources (89.34%); the remainder was provided by fossil fuels (7.35%) and other sources, such as geothermal (3.31%) (U.S. Central Intelligence Agency, 2000c). In November, the World Bank and other international donors approved a $10 million loan to Ethiopia for repairing war damage to its energy sector. Funds will be spent on rehabilitating and reconstructing power lines, powerplants, and substations (World Bank, 2000c, p. 13, 52).

Most of Ethiopia's energy needs are still met by traditional fuels, such as firewood; less than 1% of the country's rural population, which is more than 85% of the total population, has access to electricity (Dr. Fekadu Shewarega, Associate Professor, Addis Ababa University, August 20, 1999, Micro hydropower—A neglected resource in Ethiopia, accessed June 30, 2000, at URL http://www.addistribune.com/Archives/2000/08/20-08-99/Micro.htm). Many forests have become severely depleted; the resulting desertification was estimated to cost Ethiopia more than $2 billion per year (Embassy of Ethiopia, Washington, DC, January 10, 2001, Ethiopia loses over two billion USD annually to desertification, accessed January 10, 2001, at URL http://www.ethiopianembassy.org/news/dailynews/dailynews.cfm?1441). In response, the Government has launched a $160 million program to upgrade the country's energy resources.

The Ethiopian Government's plan involves building 41 new power stations, which include 7 hydropower, and installing 2,067 km of power lines. Ethiopian Electric Power Corp. (EEPC) has begun building three hydroelectric power stations, at Tis Abay, Gilgel Gibe, and Finchaa, with a total generating capacity of 291 MW. In May, EEPC announced that Alstom had won contracts to supply transformers for the Gilgel Gibe power station. Alstom was also participating in a plan to extend the power transmission network between Bhar Dar and Gondar (Africa Energy & Mining, 2000). Ethiopia's known exploitable potential hydroelectric energy is 162,000 MW (World Resources Institute and others, 1996, p. 288). The country's geothermal potential has been estimated to be 700 MW.

Ethiopia's transportation network comprised about 28,500 km of roads, of which nearly 4,300 km were paved. The Ethiopian segment of the Addis Ababa-Djibouti railroad was 681 km. About 3,900 km of the country's roads were damaged by the war with Eritrea. The World Bank and other donors approved an $86 million loan for the rehabilitation and improvement of roads and bridges (World Bank, 2000c, p. 13). In May, the Ethiopian Government announced its intention to build more than 57,000 km of trunk and rural roads by 2005 (Addis Tribune, May 5, 2000, More roads to be built in the country over the coming five years, accessed June 30, 2000, at URL http://www.addistribune.com/Archives/2000/05/05-05-00/More.htm).

The outlook for Ethiopia's mineral industry is favorable. Improvements in the general economic situation and the need to rebuild infrastructure are likely to increase demand for building materials. Exploitation of natural gas resources is likely to increase owing to the Government's ambitious plans for powerplant construction; the demand for electricity in Ethiopia far exceeds the supply. Ethiopia's plans to expand infrastructure may increase the economic viability of its rich metals and industrial minerals deposits. Favorable conditions in the world minerals markets and the success of the peace process are also important.

SOMALIA

In recent years, Somalia has been known to produce small quantities of gypsum, salt, and sepiolite (meerschaum). The minerals industry makes a small contribution to the country's exports and the economy in general. In 1999, Somalia's GDP amounted to about $4.3 billion at purchasing power parity. The per capita income at purchasing power parity was $600 in 1999. Industry accounted for about 10% of the GDP (U.S. Central Intelligence Agency, 2000d).

Officially reported mineral and trade data have been unavailable for a number of years owing to the collapse of the country's central government. The civil war that brought down the government has had considerable adverse consequences for the economy, including the minerals sector. The war has forced the closure of Somalia's cement plant and oil refinery and has halted the exploration of the country's natural gas field, the construction of a hydroelectric and irrigation scheme at Bardera on the Juba River, and the exploration for other resources.

Owing to the closure of the plant managed by the Berbera Cement Agency, Somalia imported all its cement; the International Cement Review (2001c) estimated the country's cement consumption to be 100,000 t in 2000. Most of this cement was believed to be sourced from Kenya, Oman, and Saudi Arabia.

The limestone deposits at Suria Malableh have been mined for use in the cement plant. Resources are estimated to be 11.5 Mt at a grade of 49.18% calcium oxide. Other limestone deposits that may be suitable for cement raw material are found in the central (near Belet Weine) and southern (at Bur Anole and Markabley) parts of the country. Lower grade limestone deposits are found in the north (in the Bihendula District, with an estimated resource of 20 Mt) and along the coast near Mogadishu (Chakrabarti, 1988, p. 97-98).

Somalia also has resources of gypsum. The largest deposit occurs at Suria Malableh, which has an estimated resource of 5 Mt of 80% pure gypsum and more than 2.5 Mt of 90% pure anhydrite. Material from the Suria Malableh deposit has been used to make calcinated gypsum, school chalk, and medical plaster. Plans to gradually increase gypsum production for the domestic market to 200,000 t/yr have been delayed by the war. Other gypsum deposits occur in southern Somalia close to the Belet Weine and the Bulo Burti areas (Chakrabarti, 1988, p. 90-92).

Salt brine deposits (from evaporated seawater) in northwestern Somalia near Zeila have been exploited for many years. Other brine deposits include Horio, Gesira, and Karan. Salt deposits are also found near lakes (Obbia and Agherrar in the southwest), salt springs (Heis Dagah and Darraboh in the northwest), and rock salt (Yet in the southwest).

Somalia produced small quantities of sepiolite, which was its only mineral export. The country has large deposits of sepiolite in the El Bur area. The Indho Qabyo prospect was estimated to have resources of 19 Mt of sepiolite, which included 3.5 Mt of meerschaum-quality and 15.5 Mt of sepiolitic material. Estimated resources in the El Bur area totaled about 100 Mt (Chakrabarti, 1988, p. 95-96).

Other industrial minerals found in Somalia include feldspar, kaolin, kyanite, and quartz. The country's feldspar deposits are found in Laferug, Berdale, Bur Degis, Bur Mado, Laferug, and Waaf Dhai. Kaolin has been found in the Bur Area (Bur Bur, Bur Dubud, Bur Galin, Bur Narible, and Bur Siabo) and between Las Gal and Merodile. Resources at Bur Bur were estimated to be 80,000 t of 20% pure kaolin. Deposits of kyanite are located at Damal and Geed-Deeble; the kyanite found at Damal occurs in micaceous quartzites that contain 33% kyanite and has an estimated resource of 132,000 t. Quartz crystals at the Issutugan and Wai-Wai deposits have been mined by local prospectors; before 1988, 540 kilograms of piezo-quartz raw material was recovered from Issutugan, and 6.5 t, from Wai-Wai (Chakrabarti, 1988, p. 99-100).

Somalia's deposits of tin and tantalum were mined in the mid-1970s by Technoexport Bulgaria. Three deposits are in the Dalan area. The largest has estimated resources of 2.8 Mt at a grade of 0.028% tin; the second largest has estimated resources of 1.4 Mt at a grade of 0.129% tin, 0.015% tantalum, 0.132% rubidium, and 0.011% cesium; and the smallest has an estimated resource of only 13,000 t. The Majayahan deposit was estimated to have resources of 200,000 t at a grade of 0.074% tin, 0.011% tantalum, 0.098% rubidium, and 0.036% cesium (Chakrabarti, 1988, p. 69-72).

Somalia is known to have resources of uranium. The deposit in the Ghelinser-El Bur area has an estimated resource of 8,000 t of uranium oxide (U_3O_8) from ore that grades 0.116%. The Wabo-Mirig deposit was estimated to have a resource of 5,500 t of U_3O_8 from ore that graded 0.08%. Dusa Mareb had an estimated resource of 3,000 t of U_3O_8 from ore that graded 0.08% (Chakrabarti, 1988, p. 95-96). The total uranium metal content of these estimated resources is 14,000 t. Nearly 6,700 t of the country's uranium resources were estimated to be recoverable at a world market price between $80 and $130 per kilogram. None of these resources would be recoverable at a price of less than $80 per kilogram (World Resources Institute and others, 1996, p. 288).

In the early 1990s, Somalia consumed about 314,000 t of petroleum products; more recent data are unavailable (MBendi Information Services, 2000, Somalia—Oil and gas industry—Overview, accessed March 27, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/so/p0005.htm). In 1998, Somalia produced 265 GWh of electricity, which was generated by fossil fuels (U.S. Central Intelligence Agency, 2000d). Somalia has estimated resources of 6 billion cubic meters of natural gas. The country's known exploitable potential hydroelectric energy is 50 MW (World Resources Institute and others, 1996, p. 288).

Somalia's transportation network comprised about 22,000 km of roads, of which 2,600 km were paved. The country had no rail network as of 1999. Oil pipelines were 15 km. Ports and harbors were at Bender Cassim (Boosaaso), Berbera, Chisimayu (Kismaayo), Merca, and Mogadishu (U.S. Central Intelligence Agency, 2000d).

The outlook for Somalia's mineral industry is for little change in the short run. The new central government created in August has not been recognized by the breakaway governments in Somalialand and Puntland and faces challenges from regional warlords in southern Somalia (Jane's Information Group, May 9, 2001, North Africa risk pointers—Somalia, accessed June 25, 2001, at URL http://www.janes.com/regional_news/africa_middle_east/sentinel/north_africa/somalia.shtml). Other problems include weak infrastructure and a domestic market that is limited by severe poverty. In the long run, an end to the civil war; investment in education, health, and infrastructure; favorable world market conditions; improvements in mining technology; and other conditions amenable to private foreign investment could lead to greater exploitation of Somalia's mineral resources.

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TABLE 1

ERITREA, ETHIOPIA, AND SOMALIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Country and commodity		1996	1997	1998	1999 e/	2000 e/
ERITREA						
Basalt		509,300	489,686	403,219	400,000 r/	300,000
Cement		47,031	60,000 e/	50,000 e/	50,000 r/	45,000
Clays:						
Common		81,600	80,000 e/	80,000 e/	80,000 r/	50,000
Kaolin		2,620	4,670	3,809	3,800 r/	2,000
Coral		69,269	96,535	245,112	245,000 r/	250,000
Gold	kilograms	98	612	573	570 r/	500
Granite		130,000	111,062	249,829	250,000 r/	200,000
Gravel		1,715,000	798,055	941,129	941,000 r/	500,000
Gypsum		23	27	56	56 r/	50
Laterite		1,449	585	5,881	5,880	5,880
Lime e/		7,000	7,000	6,000	6,000 r/	3,000
Limestone 4/		4,552	5,585	4,077	4,100 r/	4,000
Marble		218,300	220,000 e/	200,000 e/	200,000 r/	100,000
Petroleum products	thousand 42-gallon barrels	4,500	3,000	--	-- r/ 3/	-- 3/
Pumice		300 e/	754	391	390 r/	200
Quartz		870	604	731	730 r/	600
Salt		200,412	252,073	114,137	114,000 r/	100,000
Sand e/	thousand tons	1,500 r/	2,097 r/ 3/	2,170 r/ 3/	2,170 r/	2,000
Silica sand		1,481,100	27 r/	-- r/	-- r/	--
ETHIOPIA 5/ 6/						
Cement, hydraulic		690,000 r/	752,000 r/	750,000 r/	638,266 r/ 3/	879,962 3/
Clays: 7/						
Brick e/		7,000	6,000	6,000	80,865 r/ 3/	224,093 3/
Kaolin (China clay)		1,428 r/	3,512 r/	378 r/	681 r/ 3/	1,654 3/
Other clay	cubic meters	NA	NA	NA	23,750 3/	23,000
Columbite-tantalite, ore and concentrate:						
Gross weight	kilograms	20,000	20,000	20,000	49,630 r/ 3/	64,940 3/
Nb content	do.	NA	NA	NA	4,960 3/	6,490 3/
Ta content	do.	6,500	6,500	6,500	29,300 r/ 3/	38,800 3/
Diatomite		150	150	125	140 r/ 3/	140
Feldspar e/		4,000	5,000	5,000	391 r/ 3/	285 3/
Gold, mine output, Au content	kilograms	2,500	3,000	2,500	4,905 r/ 3/	5,177 3/
Gypsum and anhydrite, crude		124,000	120,000	120,000	35,983 r/ 3/	46,798 3/
Lime		3,100	2,500	3,000	2,991 r/ 3/	3,769 3/
Platinum, mine output, Pt content 8/		-- r/	-- r/	-- r/	-- r/ 3/	-- 3/
Pumice e/ 7/		360,000	325,000	325,000	135,400 r/ 3/	156,466 3/
Salt, rock e/		5,000	1,000	1,000	56,400 r/ 3/	56,400 3/
Scoria e/		250,000	250,000	250,000	281,164 r/ 3/	286,800
Soda ash, natural		20,000	15,000	15,000	4,745 r/ 3/	4,745 3/

See footnotes at end of table.

TABLE 1--Continued
ERITREA, ETHIOPIA, AND SOMALIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Country and commodity		1996	1997	1998	1999 e/	2000 e/
ETHIOPIA--Continued 5/ 6/						
Stone, sand, and gravel: e/ 7/						
Construction stone, crushed	thousand tons	750	750	1,000	3,407 r/ 3/	3,459 3/
Dimension stone 9/		38,000	40,000	130,000	130,000 r/	100,000
Granite		NA	NA	NA	126 3/	140
Limestone	thousand tons	3,300	3,300	3,400	846 r/ 3/	1,197 3/
Sand 10/	do.	1,600	1,600	2,500	1,600 r/ 3/	1,853 3/
Silica sand		6,000	7,000	7,000	6,061 r/ 3/	5,601 3/
Other stone		NA	NA	NA	10,162 3/	15,768 3/
SOMALIA 11/ e/						
Gypsum		1,000	1,000	1,500	1,500	1,500
Salt, marine		1,000	800	600	1,000	1,000
Sepiolite (meerschaum)		6	6	6	6	6

e/ Estimated. r/ Revised. NA Not available. -- Zero.

1/ Estimated data are rounded to no more than three significant digits.

2/ Includes data available through June 25, 2001.

3/ Reported figure.

4/ For other than cement.

5/ Data are for year ending July 7 of the year listed.

6/ In addition to the commodities listed, some lignite, semiprecious gemstones, steel semimanufactures, and talc reportedly were produced, and silver was reportedly contained in gold ingots from the Lege Dembi Mine, but information is inadequate to estimate output.

7/ When reported as volume or pieces, conversions to metric tons are estimated.

8/ No platinum production was officially reported after 1988. Some artisanal platinum probably continued to be produced, and platinum was also reported by others as being contained in gold ingots from the Lege Dembi Mine, Ethiopia, which started up in 1990.

9/ Includes marble. Production of marble was estimated to be 13,900 t in 1996 and reported to be 6,014 t in 1999 and 6,662 t in 2000.

10/ May include gravel.

11/ In addition to the commodities listed, various crude construction materials (e.g., clays, sand and gravel, crushed and dimension stone) and limestone for lime manufacture and/or agriculture are presumably produced; available information, however, is inadequate to make estimates of output.

THE MINERAL INDUSTRY OF

EGYPT

By Philip M. Mobbs

Egypt has an extensive history of mineral production; production has included construction materials (such as dimension stone, clay, and gypsum), copper, gemstones, materials for glass, gold, iron ore, and zinc. In recent decades, crude petroleum, natural gas, and refined petroleum products have dominated Egypt's mineral sector. The production of cement had become a notable segment of the mineral industry. Egypt was a modest producer of primary aluminum, steel, and ferroalloys and has secondary (remelt) production of copper, lead, and zinc. The recent rapid expansion of the steel, the cement, and the fertilizer industries had been propelled by the Government's privatization program, private development of new facilities or expansion of privatized operations, and the construction boom associated with the Government's promotion of settlement and industrial development of relatively underpopulated parts of the country, particularly near Aswan and in the Sinai.

The nation's gross domestic product (GDP) was estimated to be $98.7 billion[1] in 2000 (World Bank Group, September 17, 2001, Egypt, Arab Rep. at a glance, accessed September 28, 2001, at URL http://www.worldbank.org/data/countrydata/aag/egy_aag.pdf). The Egyptian economy was well diversified. Segments of the GDP at factor cost for the July 1, 1999, to June 30, 2000, Egyptian fiscal year (the last period for which such disaggregated data were available) included industry, manufacturing, and mining, which were combined to account for 19% of the GDP; transportation, which included Suez Canal operations, which accounted for 9% of the GDP; crude petroleum and petroleum products, which accounted for 7% of the GDP; and construction, which accounted for 6% of the GDP (Ministry of Economy, September 2001, Gross domestic product at factor cost, Monthly Economic Digest, accessed September 21, 2001, at URL http://www.economy.gov.eg/English/monthly/ 2b_GDP.htm).

Trade

According to the Ministry of Economy, Egypt's total exports in 2000 were valued at about $4.7 billion, and total imports amounted to about $14 billion. Crude oil and petroleum products accounted for about 41% of the value of total exports in 2000, which was an increase of 36% in the value of total exports in 1999. In 2000, the value of fuel imports rose to 7% of the value of total imports compared with 3% in 1999 (Ministry of Economy, September 2001, International trade by major commodity groups, Monthly Economic Digest, September 2001, accessed September 21, 2001 at URL http://www.economy.gov.eg/English/monthly/ 5e_1Trade.htm). World Bank trade statistics indicate that fuel and energy accounted for 13.7% of the value of total imports in 2000 and 7.7% in 1999 (World Bank Group, 2001, Egypt, Arab Rep. at a glance, accessed September 28, 2001, at URL http://www.worldbank.org/data/countrydata/aag/egy_aag.pdf).

The Suez Canal Authority revenues were $1.9 billion in 2000 when 14,141 ships transited the waterway compared with 13,490 vessels in 1999. Tonnage increased to 438,962 million metric tons (Mt) in 2000 compared with 384,994 Mt in 1999. In September, the Government authorized a $440 million, 10-year plan to deepen and widen the Canal. It proposed to widen the channel to 400 meters (m) from 345 m and to dredge to a sufficient depth to accommodate ships with a 21.9-m draft compared with the current 17.7-m draft limitation thus opening the canal to vessels larger than the current Suezmax classification (the domain of ships within the 110,000- to 150,000-deadweight-ton range) (American Chamber of Commerce in Egypt, June 2001, Canal revenues recovering, Business Monthly, accessed September 20, 2001, at URL http://www.amcham.org.eg/HTML/News_Publication/BusinessMonthly/June01/summ5d.htm).

Commodity Review

Metals

Aluminum.—The nation's primary aluminum producer Aluminium Co. of Egypt (Egyptalum, also known as Misr Aluminium Co.) proposed to expand its production capacity to about 300,000 metric tons per year (t/yr) by 2008. In 2000, Egyptalum's production capacity was 195,000 t/yr. By 2002, the company anticipated capacity would be 245,000 t/yr with the scheduled completion of the conversion of the cells of potline no. 5 to prebaked anodes (Mining Journal, 2000).

Iron and Steel.—In addition to several minimills that produced steel in Egypt, the two major steel production facilities were the privately owned Alexandria National Iron and Steel Co. (ANSDK)[2] and the public enterprise Egyptian Iron and Steel Co. During 2000, Al Ezz Steel Rebars Co. acquired 28% equity interest in ANSDK. ANSDK started commercial production from an 80,000-t/yr direct reduction iron plant (its third Midrex® direct reduction module at El-Dikheila steelworks near Alexandria) (Metal Bulletin, 2000c). During 2000, Suez Steel Co. started its 600,000-t/yr-capacity minimill at Adabiya, which had been built by Voest-Alpine Industrieanlagenbau GmbH & Co. (VAI). VAI subsequently was contracted to construct a FINMET® direct reduction plant for Suez Steel to be designed to produce 1.15 Mt of hot-briquetted iron (Voest-Alpine Industrieanlagenbau GmbH & Co., 2000).

General Lithograph Egypt Co. received a positive feasibility study of its proposed 100,000-t/yr-capacity electrolytic tinning line in 6 October City, which is about 50 kilometers (km) west of Cairo (Metal Bulletin, 2000a). In Sadat City, a 500,000-t/yr bar and wire rod rolling mill and a 500,000-t/yr bar rolling mill were being built for Egyptian American Steel Rolling Co. El Attal Steel had a 300,000-t/yr bar mill under construction in Suez (Metal Bulletin, 2001). The Kouta Steel Group acquired the Arab Steel Factory from the Holding Co. for Financial Investments (Lakah Group).

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[1] Where necessary, values have been converted from Egyptian pounds (E£) to U.S. dollars at the rate of E£3.4=US$1.00.

[2] Many Egyptian company and place names are transliterations and/or translations from Arabic and have variable spellings depending on the literature source. Likewise, common acronyms for some of these companies evidently correspond to the transliterated Arabic names rather than to their English translations.

Development of an iron mine near Aswan and an associated integrated iron and steel plant ceased when the Government charged the promoters with misappropriating public funds. The Government indicated that the promoters had sold equity in the Aswan Development & Mining Co. and the Aswan Iron & Steel Co. to state-owned banks on the basis of fraudulent claims (Metal Bulletin, 2000b; Middle East Economic Digest, 2001a).

Industrial Minerals

Cement.—Output from new cement plants and expanded privatized operations chased after a declining domestic market. Consumption faltered in 2000 as the expected sustained increase in cement demand failed to materialize (Privatization Coordination Support Unit, December 4, 2000, Privatization-related articles translated from the Egyptian press—ECES study indicates a decline in production rates during the first half of the year, accessed October 2, 2001, at URL http://www.carana.com/pcsu/press/2000-Nov-28.htm).

Egyptian Cement Co. (ECC) [a joint venture that included Orascom Construction Industries of Egypt (53.6% equity interest) and Holderbank Financière Glaris Ltd. of Switzerland (43.72%)] fired the third kiln at its plant in November. ECC's fourth kiln was scheduled to come online in early 2002.

In 2000, Cimentos de Portugal, SGPS, S.A., acquired 91.4% equity interest in Ameriyah Cement Co., and Suez Cement Co. secured 64.8% interest in Tourah Portland Cement Co. Sinai White Portland Cement Co. continued construction of a white cement plant.

Fertilizer.—Abu Qir Fertilizers & Chemical Industries Co. brought the 1,200-metric-ton-per-day (t/d) ammonia and 1,750-t/d urea Abu Qir III plant online in early 1999. Egypt Basic Industries Co. continued to plan construction of a 1,850-t/d ammonia plant in the new Suez Industrial Zone, which is about 20 km south of Suez (Lippmann and others, 1999, p. 15; Middle East Economic Digest, 2001b).

Mineral Fuels

Egypt had an important energy minerals sector that was dominated by the production of natural gas, crude petroleum, and refined petroleum products. The U.S. Department of Energy's general overview of the Egyptian energy sector can be found at URL http://www.eia.doe.gov/cabs/egypt2.html.

In July, negotiations on natural gas sales between the Government and the international petroleum companies were concluded. The Government obtained lower rates for the gas that it acquired and paid for the gas in local currency instead of dollars.

In 1999, two successful exploration wells on the West Gharib concession of a joint venture of Dublin International Petroleum (Egypt) Ltd. of Bermuda [a subsidiary of Tanganyika Oil Ltd. of Bermuda (a subsidiary of Tanganyika Oil Co. Ltd. of Canada)] (50% equity interest), GHP Exploration (West Gharib) Ltd. (one of several subsidiaries of Transatlantic Petroleum Corp. of Canada that were active in Egypt) (30% interest), and Drucker Petroleum Inc. (a subsidiary of Drucker Industries Inc.) (20% interest) resulted in the development of the Hana field. Production from the Hana field began on December 29, 1999, and the venture drilled several successful development wells in the field in 2000. Other successful wells drilled in Egypt during 2000 included the Akik-1X gas well, the Karama-1X oil well, the Neith South-1X oil well on the Khalda Offset concession, and the Shams-8X well on the Khalda concession for the joint venture of the Repsol-YPF Group of Spain, Apache Corp. of the United States, and Novus Petroleum Ltd. of Australia. On the Central Sinai concession, the joint venture of Alliance Egyptian National Exploration Co. and GHP Exploration (Egypt) Ltd. discovered oil with the Lagia-6 well. BG Group plc and Edison International successfully drilled the Sapphire-1, the Sapphire-2, the Sienna-1, and the Simian-3 wells on the West Delta deep marine concession.

Coplex (Egypt) Ltd. (a subsidiary Naftex Energy Corp.) and Cabre Exploration (Cyprus) Ltd. (a subsidiary of Kappa Energy Co. Inc. of Canada, which was renamed Vanguard Oil Corp. in January) drilled and completed the Tawoos-1 oil well on the West Esh El Mallaha concession. Shell Egypt N.V. and Energy Africa Ltd. drilled the JC18-1 well on the Matruh permit. In an attempt to bolster production from the Obaiyed gasfield, Badr El Din Co. (BAPETCO) (an affiliate of the Royal Dutch/Shell Group of companies) discovered gas with the Obaiyed South-1 well. Commercial gas flow from the Obaiyed field had begun in late 1999, but production rapidly declined during 2000. BAPETCO planned additional wells at Obaiyed and Obaiyed South.

Four liquefied natural gas (LNG) projects were under consideration in 2000. BG International, which in October 2000 became the BG Group, and Edison International planned to bring an LNG plant near Idku, east of Alexandria, on-stream in 2004. BP Amoco plc proposed the construction of a two-train LNG plant and a two-train natural gas liquids (NGL) plant on the Mediterranean coast. LNG shipments were to start in 2004. BP Amoco also planned to build a NGL plant on the Gulf of Suez. Royal Dutch/Shell Group proposed to construct a gas-to-liquids plant and a two-train LNG plant. By 2004, Grupo Union Fenosa of Spain planned to build a two-train LNG plant at Damietta.

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TABLE 1

EGYPT: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 e/
METALS						
Aluminum metal	metric tons	179,200	178,200	195,000	193,319	200,000
Copper, refined, secondary e/	do.	4,600 3/	5,000	6,000	6,000	5,000
Iron and steel:						
Iron ore and concentrate		2,429	2,744	3,001	3,000 e/	2,500
Metal:						
Pig iron e/		1,050	1,000	1,334 3/	700	700
Direct reduced iron		827	1,190	1,610	1,670	1,530 3/
Steel, crude		2,618	2,717	2,870	2,619	2,820 3/
Ferroalloys: e/						
Ferromanganese		35	26	18	30	30
Ferrosilicon		44	44	44	44	45
Manganese ore e/	metric tons	15,000	15,000 r/	10,000 r/	20,000 r/	20,000
Titanium, ilmenite e/		124 3/	125	125	130	125
INDUSTRIAL MINERALS						
Asbestos e/	metric tons	1,836 3/	2,000	700 r/	1,000 r/	2,000
Barite e/		--	--	300 r/	500 r/	500
Cement, hydraulic, all types		18,700	19,700	21,000	23,313 r/	24,143 3/
Clays:						
Bentonite e/		50	50	33 r/	50	50
Fire clay		350 e/	331	227	300 e/	300
Kaolin	metric tons	258,725	258,869	285,497	290,000 e/	290,000
Feldspar, crude	do.	53,783	57,335	325,654	330,000 e/	330,000
Fluorspar	do.	700	775	140	500 e/	500
Gypsum and anhydrite, crude		2,000 e/	2,423	1,338	2,000 e/	2,000
Lime e/		750	800	800	800	800
Nitrogen:						
Ammonia, N content		1,126	1,061	1,141	1,407	1,511 3/
Urea, N content		480	445	482	700	853 3/
Phosphate:						
Phosphate rock		808	1,067	1,076	1,018	1,020
P_2O_5 content		222	310	311	298	300
Sodium compounds:						
Salt		1,530	2,024	2,387	2,400 e/	2,400
Soda ash e/		50	50	50	50	50
Sodium sulfate	metric tons	2,000 e/	2,118	2,498	2,500 e/	2,500
Stone, sand and gravel:						
Basalt	thousand cubic meters	600 e/	883	241	300 e/	300
Dolomite		1,000 e/	1,324	3,444	3,500 e/	3,500
Granite, dimension stone	cubic meters	20,000 e/	24,958	35,817	40,000 e/	40,000
Gravel	thousand cubic meters	10,500 e/	12,033	11,463	12,000 e/	12,000
Limestone and similar	do.	18,300	23,559	25,618	27,000 e/	27,000
Marble (including alabaster) blocks	cubic meters	80,000 e/	127,767	134,664	140,000 e/	140,000
Sand:						
Industrial sand (glass sand)		850 e/	505	574	600 e/	600
Construction sand		22,000 e/	21,250	19,420	22,000 e/	22,000
Sandstone	thousand cubic meters	200 e/	66	6	-- e/	--
Sulfur:						
Elemental, byproduct e/	metric tons	8,000	4,453 3/	4,450	4,400	4,500
Sulfuric acid, S content		222 r/	230 r/	224 r/	214 r/	220
Talc, soapstone, pyrophyllite	metric tons	41,227	43,627	39,720	40,000 e/	40,000
Vermiculite	do.	447	447	12,376	12,000 e/	12,000
MINERAL FUELS AND RELATED MATERIALS						
Coal e/		200	300	370 3/	400	400
Coke e/		1,800	1,800	1,500	1,420	1,400
Gas, natural:						
Gross production	million cubic meters	16,800 e/	17,000 e/	18,270	19,766	25,000
Dry	do.	13,183	13,349	16,430	17,800 e/	21,000
Petroleum:						
Crude, including condensate	thousand 42-gallon barrels	336,500	313,300	304,400	311,000	290,000

See footnotes at end of table.

TABLE 1--Continued
EGYPT: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 e/
MINERAL FUELS AND RELATED MATERIALS--Continued						
Petroleum--Continued:						
Refinery products:						
Liquified petroleum gas	thousand 42-gallon barrels	5,080	6,333	5,090	5,371	5,500
Gasoline and naptha	do.	40,185	44,065	43,465	43,699	45,000
Kerosene and jet fuel	do.	17,255	16,606	15,788	15,472	16,000
Distillate fuel oil	do.	42,298	43,790	45,230	45,857	46,000
Residual fuel oil	do.	85,787	86,100	87,625	82,011	83,000
Lubricants	do.	1,645	1,729	1,820	1,834	1,800
Asphalt	do.	4,181	4,641	5,042	6,030	6,000
Unspecified 4/	do.	4,596	2,400	2,350	1,987	1,700
Total	do.	201,027	205,664	206,410	202,261	205,000

e/ Estimated. r/ Revised. -- Zero.

1/ Estimated data are rounded to no more than three significant digits.

2/ Table includes data available through September 21, 2001. In addition to those listed, Egypt produced a number of commodities for which data were unavailable; these include a number of metals, such as lead, produced by secondary recovery methods, and manufactured mineral commodities, such as carbon black and glass.

3/ Reported figure.

4/ Amounts needed to complete reported refinery products totals shown.

THE MINERAL INDUSTRY OF

EQUATORIAL GUINEA

By Philip M. Mobbs

The Republic of Equatorial Guinea consisted of a number of islands and islets, which include the volcanic island of Bioko in the Gulf of Guinea; the islands of Corisco, Elobey Chico, Elobey Grande, and Mbañe in Corisco Bay; the volcanic island of Annobón in the South Atlantic Ocean; and the Rio Muni enclave on the African mainland. In 1999 (the last year for which financial data were available), the gross domestic product of Equatorial Guinea was estimated to be about $696 million, and the population was estimated to be 442,700 (World Bank, July 2000, World development indicators database, accessed September 24, 2000, via URL http://www.worldbank.org/data/countrydata/countrydata.html). The petroleum sector has dominated the country's economy since 1996.

Mineral resources are the property of the state. Nonfuel minerals exploration and exploitation are carried out under mineral development agreements. Decree Law No. 9/1981 regulates mining activity except aggregate and radioactive minerals. The Government issues 5-year exploration licenses and allows two 1-year extensions. In 2000, surface rents were $0.25 per hectare. The royalty on gold production was 3%, and other nonfuel mineral production was subject to royalty rates of up to 5%. Petroleum exploration and production is regulated by Decree Law No. 7/1981, as amended. The model petroleum-production-sharing contract was revised in 1998. Initial exploration contracts can be drawn up for 5-year periods with two 1-year extensions; 40% of the concession area is to be relinquished at the end of the initial exploration term. In 2000, the annual surface rental during exploration was $0.50 per hectare in water depths of greater than 200 meters (m) and $1.00 per hectare for concessions in less than 200 m of water. The minimum royalty on petroleum production was 10%, and the Government reserved the right to participate in exploration and production ventures. The income tax rate started at 25%, with a maximum of 45% (Ministerio de Minas y Energia, 2000, p. 16, 18).

BoMc G-E Ltd. of the British Virgin Islands and UMC Equatorial Guinea Corp. continued to evaluate the mineral resources of Rio Muni. Previous mineral and geologic surveys of Rio Muni had identified occurrences of gold and titanium-bearing sands (Ministerio de Minas y Energia, 2000, p. 19-20). Gold was being produced by artisanal miners.

The joint venture of CMS Oil & Gas Ltd. of Equatorial Guinea (52.38 % interest), Samedan of North Africa, Inc. (33.75%), Globex International (10.87%), and the Government (3%) produced natural gas from the Alba Field in the Gulf of Guinea. In 2000, the Alba Field's natural gas production capacity was raised to 2.3 billion cubic meters per year from 930 million cubic meters per year. Alba Field will supply about 1.3 billion cubic meters per year of natural gas to Atlantic Methanol Production Co.'s (AMPCO) 2,500-metric-ton-per-day-capacity methanol plant that was projected to be operating in early 2001 (Noble Affiliates Inc., 2001, p. 10). About 21 million cubic meters per year of natural gas was used by the 10.4-megawatt Punta Europa electricity generating plant. As Alba Field production is ramped up in 2001, gas not used by AMPCO, the Punta Europa powerplant, or the Punta Europa condensate plant will be reinjected offshore. In 2000, surplus gas was flared.

On block B, the joint venture of Mobil Equatorial Guinea Inc. (71.25% working interest) (a subsidiary of Exxon Mobil Corp. of the United States), Ocean Energy Inc. of the United States (23.75%), and the Government (5%) continued development of the Zafiro Field. Crude oil production was increased to more than 112,000 barrels per day (bbl/d) in June when production from the 40-slot, 60,000-bbl/d-production-capacity Jade Platform began to be piped to processing facilities on the floating production, storage, and offloading vessel (FPSO) *Zafiro Producer* (Ocean Energy Inc., 2000). Gas lift and reinjection facilities with a capacity of about 568 million cubic meters per year were installed on the platform. In 1999, a 393-million-cubic-meter-per-year-capacity gas lift module was installed on the *Zafiro Producer* (Ministerio de Minas y Energia, 2000, p. 4). On block C, the drilling of the Oreja Marina exploration well was proposed for 2001 by the joint venture of Mobil (47%), Ocean Energy (37.6%), SK Corp. of the Republic of Korea (9.4%), and the Government (6%).

On block G, Triton Energy Ltd. of the United States (85% working interest) and Energy Africa Ltd. of South Africa (15%) began production from the Ceiba Field in November, about 13 months after the initial discovery was announced. The joint venture drilled five wells in 2000. Crude oil was delivered to the 60,000-bbl/d-of-liquid-production-capacity, 2-million-barrel-storage-capacity FPSO *Sendje Berge*, which was anchored in about 100 meters of water (U.S. Securities and Exchange Commission, March 15, 2001,Triton Energy Ltd.—Form 10-K—Fiscal year 2000, accessed May 2, 2001, at URL http://www.sec.gov/Archives/edgar/data/1009404/0001009404015000010/0001009404-01-500010.txt).

During 2000, block H was leased to Atlas Petroleum International Ltd. of Nigeria. Roc Oil Co. Ltd. of Australia subsequently acquired 60% working interest in the block. Atlas also acquired blocks I and J. Corisco Deep (block K) was leased to Vanco International Ltd. (a subsidiary of Vanco Energy Co. of the United States). Chevron Overseas Petroleum Inc. acquired 100% working interest in block L. The deepwater turbidite area south and southwest of Bioko offers significant potential for additional hydrocarbon discoveries.

Additional oilfield support port facilities were being developing at Luba. Petroleum production has resulted in a significant economic expansion in Equatorial Guinea and has severely strained the nation's infrastructure (Farah, 2001). The financial stimulus, however, has allowed the Government to consider diversification of the national economy.

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Major Source of Information

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TABLE 1
EQUATORIAL GUINEA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand 42-gallon barrels unless otherwise specified)

Commodity 2/		1996	1997	1998	1999	2000
Crude oil and condensate		6,300	21,000	30,000	33,000 r/	39,000
Liquified petroleum gases		--	450	660	800	800
Natural gas 3/	million cubic meters	--	44	78	83	98

r/ Revised. -- Zero.

1/ Includes data available through May 1, 2001.

2/ In addition to the commodities listed, Equatorial Guinea presumably produced a variety of crude construction materials (clay, gravel, and sand). There also is artisanal production of gold, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

3/ Total natural gas production was estimated to be about 800 million cubic meters in 2000. Prior to January 1997, most produced natural gas was flared. Since January 1997, produced natural gas has been processed to recover liquified petroleum gases, and since 1999, natural gas also has been used to fuel the Punta Europa electricity generating plant. About 22 million cubic meters per year of natural gas was used to power the Zafiro Producer.

THE MINERAL INDUSTRIES OF

THE GAMBIA, GUINEA-BISSAU, AND SENEGAL

By Philip A. Szczesniak

THE GAMBIA

The mineral industry of The Gambia was a minor component of the national economy, with some oil exploration and production of clays for brick, laterite, sand and gravel, and silica sand. The Gambian economy was dominated by agriculture and tourism.

Fusion Oil and Gas plc of Australia signed a 6-year oil exploration/production license for a 5,000-square-kilometer (km^2) offshore tract (World Oil, 2000, p. 91). Other companies with oil interests in The Gambia were Planet Oil International plc (a subsidiary of Hardman Resources NL of Australia) and Balmain Resources Pty Ltd. of Australia.

Carnegie Corporation Ltd. of Australia announced positive results of a test for zircon in a high-grade stockpile within their license area in The Gambia; the company noted that arranging efficient and low-cost operations to produce a commercially salable zircon product was possible (Carnegie Corporation Ltd., September 30, 2000, Review of operations, accessed March 7, 2001, at URL http://www.carnegiecorp.com.au/reports/qtr30sept00.htm).

Two additional mineral deposits under examination were the Abuko quartz sand deposit and the Sanyang heavy minerals deposit. The Abuko deposit contains more than 5 million metric tons (Mt) of quartz sand that may be used in the production of glass products. The estimated investment for further development was $225,000 (Mines '98, 1998, Abuko quartz sand—The Gambia, accessed June 12, 2001, at URL http://www.mines98.com/projects/20.htm). The Sanyang deposit contains 1 Mt of heavy minerals at a 1% cutoff grade. An investment of $252,000 would be needed for geologic exploration, chemical analysis, and bulk sample and pilot plant testing (Mines '98, 1998, Sanyang heavy minerals deposit—The Gambia, accessed June 12, 2001, at URL http://www.mines98.com/projects/21.htm).

GUINEA-BISSAU

In 2000, a new Government was elected in Guinea-Bissau; the election was seen as another step toward ending military conflicts that followed a military coup in June 1998. Barring that of the construction industry, mineral production was not significant during the year. Agriculture accounted for more than 60% of Guinea-Bissau's gross domestic product. Mining activities in the country were limited to small-scale production of construction materials, such as clay, granite, limestone, and sand. Bauxite, diamonds, gold, and phosphate were among the most promising minerals in the country owing to their potential for economic development.

In November 1999, the Government of Guinea-Bissau passed a new mining law to reform mineral exploration and mine development and production. The new Mines and Minerals Act allows a maximum lease size of 10,000 hectares (ha) for exploration and mining, an unlimited area for prospecting licenses, and 1 to 4 ha (contiguous) for artisanal mining. Mining leases are valid for 25 years and can be automatically renewed upon application. Prospecting licenses are granted for 2-year periods with unlimited renewals.

The country's proven mineral reserves consisted of 110 Mt of bauxite at an average grade of 44% Al_2O_3 and 4% SiO_2 and 100 Mt of phosphate rock that contains 30% P_2O_5 (U.S. Agency for International Development, 1998, Guinea-Bissau investing—Location specific mining and offshore drilling, accessed November 3, 1998, at URL http://www.investgb.com/engv/emine.html). Phosphate deposits are located in the Farim area 75 kilometers (km) northeast of the capital of Bissau, and bauxite deposits are located in the Boe region approximately 150 km east of Bissau.

Champion Resources, Inc. (CRI), of Canada announced an increase in the future productivity at its Farim deposit of phosphate from 1.8 to 2.1 Mt at a grade of 32.3% P_2O_5. In November 2000, CRI reported that it was seeking a partner from either India or the Middle East to help develop the Farim Mine. Production of phosphate rock was scheduled to begin in 2002 with an anticipated life of 25 years (Africa Mining Intelligence, 2000, p. 4). CRI also announced positive results from a diamond baseline sampling program conducted in 2000. Their results indicated that two out of eight samples collected from streams in the eastern portion of Guinea-Bissau contained diamond indicator minerals (Champion Resources Inc., April 19, 2001, Diamonds in Guinea-Bissau, accessed October 25, 2001, at URL http://www.championresources.com/s/NewsReleases.asp?ReportID=24298).

In 1995, a border dispute between Guinea-Bissau and Senegal was settled, and joint oil exploitation was permitted by the ratification of a treaty in which 85% of the proceeds from the activities in the area was to go to Senegal and 15%, to Guinea-Bissau. The offshore region of Guinea-Bissau was divided into four blocks. The oil and gas industry in Guinea-Bissau is regulated by the Ministry of Natural Resources and Industry. The national oil company of Guinea-Bissau was Petroguin. Foreign oil companies with interests in Guinea-Bissau were Fortesa Oil Exploration Company of the United States, Fusion Oil and Gas plc, Petrobank Energy and Resources Ltd. of Canada, and Tullow Oil plc of Ireland.

Refined petroleum products are imported. Fuel products were distributed by Distribudora de Combustiveis e Lubrificantes and Petrogal, which was a Portuguese oil company that operated in Bissau. The organization responsible for the generation and transmission of electricity was the state-owned Instituto Nacional de Energia.

SENEGAL

In April 2000, a new Government was elected in Senegal. Among a number of priorities outlined by the President were the increase of agricultural production and the development of the country's inadequate infrastructure by improving the highway system, modernizing the railroads, and constructing a new airport (Craig, 2000). Senegal's mineral sector activity was dominated by phosphate rock production and gold and petroleum exploration. Most of the phosphate rock produced by the country was processed domestically and converted to fertilizers and phosphoric acid. Gold was produced in minor amounts, although many foreign companies had active exploration permits in the southeastern part of the country where Precambrian (Birimian) metamorphic rocks are exposed.

The Direction des Mines et de la Geologie reported that annual production of artisanal gold was estimated to be 550 kilograms. The Societe Miniere de Sabodala continued to search for partners for its gold operations at Sabodala where significant reserves of gold have been reported (Direction des Mines et de la Geologie, 2000, Gold of Sabodala, accessed May 25, 2001, at URL http://www.energie.gouv.sn/DMG/Framdmg.htm). Ashanti Goldfields Co. Ltd. of Ghana, Avgold Ltd. of South Africa, Cluff Mining plc of the United Kingdom, Durban Roodepoort Deep Ltd. of South Africa, Etruscan Resources, Inc., of Canada, and IAMGOLD Corp. of Canada were among the companies that had active exploration permits in Senegal in 2000.

IAMGOLD reported positive results from its trenching and drilling program for its Bambadji Group properties in eastern Senegal. In addition, it continued exploration work on the Daorala-Boto concession, which the company has solely owned since 1998 when Ashanti relinquished its participation in the project. IAMGOLD and Ashanti continued exploration on the Mako concession. Cluff Mining was awarded the 380-km^2 Niokolo gold and base-metal permit in the eastern greenstone belt of Senegal. Etruscan Resources, which had acquired a 90% equity interest in Secor Geomin Mining and Development Corp. in 1998, held the Bousankouba permit in eastern Senegal. Exploration activities had identified a regional gold-arsenic anomaly in the area. The property, however, remained inactive during 2000 as the company focused on the development of its Samira Hill gold project in Niger (Etruscan Resources Ltd., 2000, p. 10).

In 1999, Hargraves Resources NL of Australia was taken over by Durban Roodepoort Deep. The company was granted a gold exploration license in 1999 that was valid for 4 years in the Tambakounda region of eastern Senegal. Avgold continued exploration on the Sonkounkou permit in southeastern Senegal. The joint venture of Prospector International Resources Inc. of Canada, Sengold Mining NL of Senegal, and Tarcoola Ltd. of Australia continued exploration work on the Maura property in southeastern Senegal.

Significant iron ore reserves have been estimated in the Faleme deposit and in the Farangalia and the Goto deposits. Société des Mines de Fer du Senegal Oriental (MIFERSO) [a joint venture between the Government of Senegal (28%), the Bureau de Recherches Geologiques et Minieres of France (24%), AGEM Ltd. of Canada (24%), and ThyssenKrupp of Germany (24%)] forecast production of 12 million metric tons per year (Mt/yr) of iron ore. An estimated $800 million is needed for development of the mines and the construction of a railway and mineral port (Direction des Mines et de la Geologie, 2000, MIFERSO, accessed May 25, 2001, at URL http://www.energie.gouv.sn/DMG/miferso.htm; U.S. Department of State, July 2001, Dakar, Senegal Country Commercial Guide, accessed October 31, 2001, at URL http://www.dakarcom.com/CCG/ccg2001.htm).

Ciments du Sahel S.A. of Senegal continued to plan for the construction of a second cement plant. The plant will have a capacity of 600,000 metric tons per year (t/yr) of cement and will be located about 50 km southeast of Dakar (F.L.Smidth, March 21, 2001, F.L.Smidth wins 30m euro contract in Senegal, accessed October 25, 2001, at URL http://www.flsmidth.dk/news/c72.htm).

Phosphate was produced at the Taiba Mine, which was operated by Compagnie Senegalaise des Phosphates de Taiba. Other phosphate deposits exist in the country. The Matam deposit, which contained reserves of 40.5 Mt, was among the country's future targets for exploitation. Industries Chimiques du Senegal planned to invest $1 million in the construction of a new phosphate mine in the Matam area. Overall, phosphate production contributes about 17% of Senegal's export earnings (Mining Journal, 2000).

Senegal's oil industry was regulated by the Ministry of Energy, Mines and Industries. The Société des Petroles du Senegal (PETROSEN), which is the national oil company, was responsible for all hydrocarbon exploration activities. Hydrocarbon exploration and production in Senegal were regulated by law No. 98-05 of January 5, 1998 (PETROSEN, 1998, Petroleum legislation, accessed June 14, 2001, at URL http://www.petrosen.com/legal.htm).

In 2000, natural gas was produced from the Diam Niadio East Field by Tullow Oil plc in association with PETROSEN and SAIM. By the end of the year, Tullow Oil decided not to renew its Sebikhotane license and ceased all activities in the country (Tullow Oil, April 12, 2001, Senegal report, accessed June 11, 2001, at URL http://www.tullowoil.ie/ver4/explore/sngl/1.html). The country's natural gas reserves, which are estimated to be 3 billion cubic meters, are located primarily onshore (Mbendi Information Service (Pty.) Ltd., September 29, 2000, Senegal oil and gas industry, accessed November 28, 2000, at URL http://mbendi.co.za/indy/oilg/af/sn/p0005.htm).

Companies involved in offshore exploration were Fusion Oil and Gas plc, Roc Oil Co. Ltd. of Australia, Vanco Energy Co. of the United States, and Woodside Petroleum Ltd. of Australia. In October 2000, Roc Oil executed an agreement with Woodside Petroleum to acquire a 46.25% interest in Roc's three Casamance exploration blocks, offshore Senegal (Roc Oil Co. Ltd., October 2000, Senegal operations, accessed March 27, 2001, at URL http://www.rocoil.com.au/Pages/ASX_Releases/2000_Releases/October-2000.html). Vanco Energy began exploration on its Dakar Offshore Profond block; this 32,108-km^2 area, which stretches from its offshore boundary with

Gambia to Mauritania, is considered to be the largest Senegalese oil license to date. Vanco Energy was the operator of the concession that held a 90% interest; the remaining 10% was held by PETROSEN (Vanco Energy Co., January 3, 2000, Vanco completes 2d survey offshore Senegal, accessed June 12, 2001, at URL http://www.vancoenergy.com/press/press_copy_latest-010300.html). Fusion Oil and Gas was also awarded exploration permits offshore Senegal—a 92% operating interest in Croix du Sud deepwater license offshore Senegal/Guinea Bissau and a 10% operating interest in Cheval Marin deepwater license offshore Senegal/Guinea Bissau. After completing oil exploration activities in the Dome Flore field in 2000, Benton Oil and Gas Co. of the United States decided to cease activities in Senegal (Alexander's Gas and Oil Connections, February 7, 2000, Benton in lol with Schlumberger to develop South Monagas in Venezuela, accessed October 31, 2001, at URL http://www.gasandoil.com/goc/company/cnl00655.htm).

Senegal's petroleum refining company Societe Africaine de Raffinage, which was located in Dakar, processed about 770,000 t/yr of imported crude oil. The refinery's capacity was about 1 Mt/yr of oil (Mbendi Information Services, September 29, 2000, Senegal oil and gas industry, accessed November 28, 2000, at URL http://mbendi.co.za/indy/oilg/af/sn/p0005.htm).

In October 2000, Senegal signed a memorandum of understanding with 13 countries for the establishment of the West African Power Pool (WAPP). The WAPP will be created in two phases and fully implemented by 2005 (Guardian, October 6, 2000, 13 ECOWAS states sign energy pact, accessed October 6, 2000, at URL http://www.ngrguardiannews.com/news2/nn799303.html).

Societe Nationale d'Electricite (SENELEC) was responsible for generating, transmitting, and distributing the majority of Senegal's electricity. In 2000, the Government announced that a concession contract that involved SENELEC and a consortium of Hydro Quebec of Canada and Lyonnaise de Eaux of France was broken off.

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TABLE 1
THE GAMBIA AND SENEGAL: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

		1996	1997	1998	1999	2000
THE GAMBIA 3/						
Clay	metric tons	1,000	1,200 4/	1,200	1,200	1,200
Silica sand		452 4/	303 4/	270 4/	250	250
SENEGAL 5/						
Cement, hydraulic		811 4/	854 4/	1,000	1,000	1,000
Clays, fuller's earth (attapulgite)		100	80	80	136 r/	131
Gold 6/	kilograms	550	550	550	550	550
Petroleum:						
Natural gas	thousand cubic meters	56,600	56,000	56,000	56,000	56,000
Crude oil	thousand 42-gallon barrels	1	1	1	1	1
Refinery products	do.	2,500	6,000	6,000	6,000	6,000
Phosphate rock and related products:						
Calcium phosphate-based fertilizers		160	160	160	160	160
Crude rock:						
Aluminum phosphate		30	20	20	31 r/	182
Calcium phosphate		1,340	1,565 4/	1,478 4/	2,000 r/	2,000
Phosphoric acid		300	300	300	300 r/	300
Salt		120	120	139	130 r/	130

r/ Revised.

1/ Estimated data are rounded to no more than three significant digits.

2/ Includes data available through June 2001.

3/ In addition to the commodities listed, The Gambia also produced a variety of construction materials (laterite, sand, and shell), but information is inadequate to make reliable estimates of output levels.

4/ Reported figure.

5/ In addition to the commodities listed, Senegal also produced clays, sand and gravel, and stone for local construction purposes, and limestone for cement, but information is inadequate to make reliable estimates of output levels.

6/ Government estimate of unreported production of artisinal gold.

THE MINERAL INDUSTRY OF

GHANA

By George J. Coakley

The West African nation of Ghana covers an area of 238,540 square kilometers and supported a population of around 19.5 million in mid-2000. During the presidential election year of 2000, the economy experienced a downturn because of a high level of indebtedness, a high rate of inflation, a massive currency depreciation, and weak international prices for its major exports (cocoa, gold, and timber). The Ministry of Finance reported that the gross domestic product (GDP) grew at a rate of 3.7% in 2000, or 0.7% lower than that of 1999; inflation doubled to 25.2% at yearend 2000 from 12.4% at yearend 1999; the Ghanaian cedi (C) depreciated by more than 50% against the dollar from C3,550 at the beginning of the year to C6,800 at yearend; and Ghana's external debt totaled $5.8 billion. Total indebtedness of $7.5 billion was equal to 224% of exports, 709% of budget revenues, and 124% of the GDP (Ghana Ministry of Finance, March 9, 2001, The budget statement and economic policy of the Government of Ghana for the 2001 financial year, accessed May 5, 2001, at URL http://www.ghanareview.com/Budget2001.htm#top).

Ghana was the second largest gold producer in Africa after South Africa, the third largest African producer of aluminum metal and manganese ore, and a significant producer of bauxite and diamond. Production of major mineral commodities are listed in table 1. In addition, a number of industrial minerals, which included clays (kaolin), dimension stone, limestone, salt, sand and gravel, and silica sand, were produced on a small scale (Barning, 1997, p. 1.). With the drop in gold prices and the subsequent efforts by the gold companies to rationalize production and costs, gold production appears to have peaked in Ghana at nearly 80 metric tons (t) in 1999. Gold production in 2000 decreased by 10% to 72 t compared with that of 1999. The decrease in gold production was attributed to the closure of the Teberbie Mine and surface mining operations at Ashanti Goldfields Co. Ltd.'s Obuasi Mine complex. On the basis of a review of all gold company closures, expansion, and new investment plans, gold production was expected to remain around 72 t in 2001. Development of Normandy Ghana Gold Ltd.'s new Yamfo-Sefwi gold deposit could see national production returning to the 76- to 79-t range between 2002 and 2004 but tapering off again as the known and economic gold resources at Bogosu Gold Ltd.'s (BGL) Bogosu Mine, Abosso Goldfields Ltd.'s Damang Mine, and Resolute Amansie Ltd.'s Obaton Mine become depleted. A 15% to 25% increase in the world gold price, however, could stimulate new exploration and access to lower grade ores and extend the life of these mines.

Provisional trade data for 2000 indicated an overall merchandise trade deficit of $892 million. Total estimated exports declined to $1,940.4 million compared with $2,012.1 million in 1999. Mineral exports for 2000 were estimated to be approximately $984 million, or about 51% of total exports. Major mineral exports included $702 million from gold, an estimated $20.6 million from manganese, $15 million from diamonds, and $12.8 million from bauxite. Ghana's main processed mineral commodity export was primary aluminum, which was toll-refined by Volta Aluminum Co. (Valco) from imported alumina. On the basis of the average price of aluminum of $1.65 per kilogram ($0.75 per pound) in 2000, aluminum production of 142,000 t, most of which was exported, was valued at about $235 million. Total imports of $2,832.4 million declined by 12.3% from those of 1999. Imports of crude oil and refined oil products increased to $520.1 million in 2000 from $333.3 million in 1999 as a result of an increase in crude oil prices to more than $30 per barrel from $18 per barrel. Other mineral- or mining-related imports included alumina for aluminum production, clinker, gypsum and limestone for cement production, fertilizers, and sodium cyanide for gold leaching.

Structure of the Mineral Industry

Through privatization programs during the 1990s, the Government had greatly reduced its once-dominant stake in cement and gold companies but has maintained a controlling interest in Ghana Consolidated Diamonds Ltd., Ghana National Petroleum Corp. (GNPC), and the state-run Tema Steel Co.

Efforts to attract foreign investment in recent years have brought in a wide range of companies from Australia, Canada, Ireland, South Africa, the United Kingdom, and the United States, which held controlling interests in most of the mines in Ghana (table 2). The issuance of reconnaissance and prospecting licenses by the Ghana Minerals Commission dropped to 4 in 2000 from 62 in 1997 owing to the decrease in exploration risk capital and the weakening gold price, thus prompting the Ghana Chamber of Mines to ask for review of the 1986 Mining Law to increase incentives to foreign investors (Gri BEF News Ghana, April 5, 2001, Chamber of Mines calls for review of mining law, accessed May 5, 2001, at URL http://mclglobal.com/History/Apr2001/d1bcal.html). Kaiser Aluminum Corp. of the United States maintained its longstanding 90% interest in the Valco aluminum smelter and was the major consumer of hydroelectric power supplied by the state-owned Volta River Authority (VRA).

Commodity Review

Metals

Aluminum and Bauxite.—Valco's smelter at Tema Harbor was majority owned and operated by Kaiser Aluminum & Chemical Co. of the United States. Valco's fluctuating operating level resulted from the amount of power that it has been allocated by the VRA under a contract agreement that is valid until 2017. VRA power allocations have been restricted by droughts and low water levels in the Akosombo Dam. The operating level at Valco between 1996 and 2000 has ranged from one to four out of a total of five potlines; during 2000, Valco operated an average of four potlines. Subject to Parliamentary approval in 2001, Valco and the VRA reached an agreement that would provide for sufficient power to operate at least four of Valco's five potlines in 2001 and at least three and one-half potlines thereafter (Kaiser Aluminum & Chemical Corp., March 30, 2001, Form 10-K for 2000, accessed May 5, 2001, at URL http://www.sec.gov/Archives/edgar/data/54291/0000950129-00 -001099.txt).

Ghana Bauxite Co. Ltd. (GBC), which was owned by Alcan Aluminum Ltd. of Canada, operated the country's only bauxite mine at Awaso, which has been in production since 1941. In 2000, GBC operated at slightly over its nominal capacity of 500,000 metric tons per year of salable bauxite. GBC planned an expansion program to increase export capacity to 1 million metric tons per year (Mt/yr) of bauxite by 2003, which would also require an upgrade of the railroad from the mine to the export harbor at Takoradi.

Gold.—Of the 11 major gold mines in operation in Ghana in 2000, the 4 largest accounted for a total of nearly 70% of the recorded gold output of the country—the Obuasi (27.7%), the Tarkwa (15.6%), the Damang (13.7%), and the Bibiani (11.8%). A breakdown of gold production, by mine, from 1996 to 2000 is listed in table 3.

In 2000, Ashanti's corporate gold production from seven mines in Ghana, Guinea, Tanzania, and Zimbabwe totaled 54,035 kilograms (kg), of which approximately 66% was from operations in Ghana compared with 78% in 1999. The decline from Ghana's total share in Ashanti's production was because of the closure of the high-cost Obuasi surface mining and leaching operations in Ghana and the opening of its new Geita Mine in Tanzania during 2000. By mid-2000, all production of underground sulfide ore at Obuasi was optimized to produce at a rate of 17,100 kilograms per year (kg/yr) of gold. All underground ore passed through the upgraded Sulphide Treatment Plant (STP), which used the bacterial leaching process (BIOX) to treat 3 Mt/yr of ore. The company began to recover from its hedging-related liquidity crisis of 1999 owing mainly to its sale of a 50% interest in the Geita gold project to AngloGold Ltd. for $205 million in cash and a commitment by AngloGold to provide $130 million of the project financing to the Geita project. Ashanti reduced its total debt level by 47% from its peak in 1999 to $366 million during 2000. The company was continuing to restructure its gold hedge book to minimize its exposure to margin calls by 2003 (Ashanti Goldfields Co. Ltd., 2001, p. 2-6).

Production increased by 4% to 5% at Ashanti's Bibiani and Iduapriem Mines but dropped by 18% at the Ayanfuri Mine compared with that of 1999. During 2000, work at Obuasi included continued development work and track installation on the main haulage level to the north and south of the mine, sinking and lining of the Sansu ventilation shaft, and development and support of the Kwesi Renner Shaft crusher station. Exploration focused on upgrading ore from resource to reserve status and locating extensions of the reserves at the Obuasi deposit.

The Iduapriem Mine was nearing depletion by yearend 1999; in late 2000, however, Ashanti purchased the Teberebie Mine, which is immediately south of Iduapriem, from Pioneer Goldfields Ltd. of the United States for $18.8 million. The acquisition of this mine would provide Ashanti with additional ore reserves of 37.2 million metric tons (Mt) at a grade of 1.71 grams per metric ton (g/t) gold that will extend the life of the Iduapriem Mine by more than 9 years (Ashanti Goldfields Co. Ltd., 2001, p. 10). Ashanti, in turn, signed an agreement to sell Teberebie's North Pit, gyratory crusher, and heap-leach pads to Gold Fields (Ghana) Ltd., which was the owner of the Tarkwa Mine; the mine is adjacent to the northeastern boundary of Teberebie (Ashanti Goldfields Co. Ltd., May 12, 2000, Ashanti Goldfields Co. Ltd. announces acquisition of Pioneer Goldfields Ltd., accessed June 1, 2000, at URL http://www.ashantigold.com/12may2000.htm). The sulfide reserves, which were no longer economically treatable at Teberebie's heap-leach operation, would be trucked to the Iduapriem carbon-in-leach (CIL) plant for treatment. After operating at a loss for 3 years, Pioneer decided to discontinue its operations at Teberebie during the second quarter of 1999 and ended mining by yearend (Pioneer Goldfields Ltd., March 22, 2000, Form 10-K, accessed August 11, 2000, at URL http://www.sec.gov/Archives/edgar/data/733060/0000950135-00-001553.txt). During 2000, Ashanti continued to leach the ore stacked at Teberebie where 839 kg of gold was recovered.

On January 25, Ashanti purchased Birim Goldfields Inc. of Canada's Dunkwa-Mampon property and its 21,770-kg gold resource for $1.5 million and future royalties. Approximately 30% of the gold resource at Mampon is extractable by open pit. Mampon is along the Ashanti structural trend and south of Obuasi. The Dunkwa-Mampon property had been previously held by Battle Mountain Gold Co. of the United States (Birim Goldfields Inc., 2000, p. 5).

At the end of 2000, Ashanti reported measured and indicated resources of 187.3 Mt at an average grade of 4.36 g/t gold, of which underground measured and indicated resources at Obuasi accounted for 56 Mt at a grade of 10 g/t gold, at its four mines in Ghana. The total reported measured and indicated resources estimates represented more than 817 t, or 25 million ounces of contained gold. Reported proved and probable ore reserves at its four mines in Ghana as of December 31, 2000, were estimated by Ashanti to be 101 Mt at an average grade of 4.39 g/t gold, of which underground proved and probable reserves at Obuasi accounted for 41.8 Mt at a grade of 7.9 g/t gold (Ashanti Goldfields Co. Ltd., 2001, p 22).

Gold Fields held a 71% interest in and operated the new Tarkwa surface mine and heap-leaching operation, which was the second largest gold operation in Ghana. Underground mining at Tarkwa, which had produced gold from the quartz pebble "Banket" conglomerate of the upper Tarkwaian Group since 1878, ceased operations in October 1999. On the basis of company quarterly reports for calendar year 2000, the Tarkwa surface mine, in its second full year of operation, processed 8.8 Mt of ore that yielded an average of 1.25 g/t gold and a total of 11,272 kg of gold; this was a 66% increase compared with that of 1999 (Gold Fields Ghana Ltd., [undated], Individual mine quarterly history, accessed February 9, 2001, at URL http://www.goldfields.co.za/quart_hist/qrt_hist_f.htm).

In addition to planned phased development of the Tarkwa operation, production increases were attributed to the acquisition of certain of Teberebie Mine assets from Ashanti in August. For $4.4 million, Gold Fields acquired Teberebie heap-leach pads and associated crushing, agglomeration, and stacking facilities as well as approximately 31,100 kg of Teberebie North Pit gold resources, all of which were adjacent to the Tarkwa Mine. The crushing system processed 300,000 metric tons per month and, when fully integrated with Tarkwa, would bring crushing capacity to 11 Mt/yr and gold production levels to 12,440 kg/yr in the near term. Gold Fields expected to complete its feasibility study on Phase III development of Tarkwa by mid-2001. Phase III would expand the metallurgical complex through the construction of screening and desliming operations, as well as a mill to process deeper and less porous ore. A go-ahead decision on Phase III would bring Tarkwa up to its full planned capacity of more than15,550 kg/yr of gold [Gold Fields (Ghana) Ltd., August 25, 2000, Gold Fields Ghana completes acquisition of Teberbie assets, accessed September 2, 2000, at URL http://www.goldfields.co.za/pre_ann/press/press2000/2000august25.html].

The company reported the following resources and reserves at its Tarkwa Mine as of June 30, 2000, based on a gold price of $285 per troy ounce and a cutoff grade of 0.5 g/t gold. Near-surface measured, indicated, and inferred resources at Tarkwa were estimated to be 285.8 Mt of ore at an average grade of 1.5 g/t gold for a total resource of 440,180 kg of contained gold, of which proven and probable reserves were estimated to be 142.9 Mt at an average grade of 1.4 g/t gold for a total resource of 201,800 kg of contained gold. Reserve estimates were based on a $300 per ounce gold price and a 0.5-g/t cutoff for Tarkwa. An additional 12,750 kg of gold was contained in probable reserves at Teberbie (Gold Fields Ltd., September 1, 2000, Gold Fields Ltd. annual report—Resources and reserves, accessed February 12, 2001, via URL http://www.goldfields.co.za/annual_report/ar2000/commentary.htm).

Abosso, which was owned by Ranger Minerals Ltd. of Australia, operated the Damang gold mine and CIL plant, which were located 30 kilometers (km) northeast of Tarkwa. Production shown in table 3 for Damang was for calendar years 1998 to 2000. For Ranger Minerals' financial year that ended June 30, 2000, however, Abosso had mined 3.94 Mt of run-of-mine ore at a grade of 3.05 g/t gold and 1.89 Mt of low- and medium-grade ore that averaged 1.21 g/t gold. An additional 7.7 Mt of waste was removed. The mill treated 4.12 Mt of ore at a grade of 2.81 g/t to yield 10,805 kg of gold based on a 93% recovery rate (Ranger Minerals Ltd., 2000, Financials—Quarterly reports—Quarterly report ending 31 June 2000, accessed September 11, 2000, via URL http://www.ranger.com.au). During the 6 months that ended on December 31, 2000, Damang began treating a higher proportion of primary ore and milled 2.27 Mt of ore at an average grade of 2.51 g/t gold and refined 5,068 kg of gold. By yearend, mine stockpiles included 709,000 t of run-of-mine high-grade ore that averaged 2.45 g/t gold and 10.4 Mt of low- and medium-grade material that averaged 1.08 g/t gold (Ranger Minerals Ltd., 2000, Financials—Quarterly reports—Quarterly report ending 31 December 2000, accessed May 11, 2001, via URL http://www.ranger.com.au).

New mineral resources estimates, which were based on exploration drilling during the second half of 2000, were reported as of March 31, 2001, using a long-term gold price of $300 per ounce. Proven and probable reserves were reported to be 15.32 Mt of in situ material at a grade of 2.26 g/t gold and 9.1 Mt of stockpiled ore at a grade of 1.25 g/t gold. Total measured, indicated, and inferred resources were estimated to be 41.6 Mt at a grade of 2.26 g/t gold. Ranger also announced resource estimates for the Lima-Kwesi placer gold prospect, which was located on the eastern limb of the Damang anticline. Measured, indicated, and inferred oxide resources at Lima-Kwesi were estimated to be 5.3 Mt at a grade of 0.99 g/t gold. Ranger planned to access this material in early 2003 during the postmining phase at Damang to supplement the milling of fresh medium-grade ore. Drilling of a similar prospect, Tomento, on the western limb of the anticline was continuing (Ranger Minerals Ltd., 2000, Financials—Quarterly reports—Quarterly report ending 31 March 2001, accessed May 11, 2001, via URL http://www.ranger.com.au).

Resolute Amansie (owned by Resolute Ltd. of Australia) operated the Obotan gold mine and CIL plant. Obotan was located near Manso-Nkran, which is 47 km west of Obuasi. With the depletion of near-surface oxide ore at the Adubiaso Hill section of the mine, Resolute Amansie installed a new secondary/tertiary crusher to treat the harder primary ore encountered during 2000. The company also was installing a small oxygen plant to inject oxygen into the CIL circuit to increase dissolved oxygen and recovery rates. The new oxygen plant was expected to be operational by March 2001. According to quarterly reports for calendar year 2000, Resolute Amansie milled 1.72 Mt of ore at Obotan at grades that ranged from 2.38 to 2.87 g/t gold at recovery rates that averaged between 96% and 98.2%. During 2000, 4,199 kg of gold was produced; this was more than its original planned output levels of 3,730 kg/yr of gold (Resolute Ltd., Latest news—Quarterly reports, accessed May 3, 2001, via URL http://www.resolute-ltd.com.au). Resolute Amansie reported reserve and resources as of June 30, 2000, for Obotan and the Konongo project, which was inactive in 2000. Obotan contained 1.34 Mt of proved reserves at a grade 2.5 g/t gold and 0.59 Mt of probable reserves at a grade of 2.4 g/t gold. Obotan reserves were contained within mineral resources estimated to be 4.16 Mt measured resources at a grade of 2.4 g/t gold, 2.24 Mt of indicated resources at a grade of 2.8 g/t gold, and 0.6 Mt of inferred resources at a grade of 3.8 g/t gold. Measured, indicated, and inferred gold resources at Konongo were estimated to be 3.75 Mt at a grade of 2.4 g/t gold, 4.47 Mt at a grade of 1.7 g/t gold, and 5.6 Mt at a grade of 2.1 g/t gold, respectively (Resolute Ltd., September 27, 2000, Resolute Ltd. annual report for 2000, accessed May 3, 2001, via URL http://www.resolute-ltd.com.au).

Satellite Goldfields Ltd., which was owned by Glencar Mining plc. of Ireland through its Wassa Holdings Ltd. subsidiary, operated the Wassa gold open pit and heap-leach project, which was located about 35 km northeast of Tarkwa. During early 2000, Glencar installed a new leach pad designed to allow improved solution control and management and ultimately gold recovery rates; the heap leach operation had problems with poor gold recovery since its startup in 1998. The new leach system helped increase production to 3,266 kg in 2000 from 2,712 kg in 1999. Following continuing poor leach recovery results in the first 2 months of 2001 and its inability to meet its planned design rate of 4,043 kg/yr of gold, Glencar announced that it was unlikely to recover its more than $40 million investment in the Wassa Mine (Glencar Mining plc., March 5, 2001, Wassa update, Press Release, accessed May 2, 2001, at URL http://www.glencarmining.ie/press/2001.htm). Proven and probable ore reserves as of December 31, 1999, were 15.1 Mt at a grade of 1.52 g/t. Measured and indicated resources were estimated to be 32 Mt at a grade of 1.34 g/t gold (Glencar Mining plc., 2000, p. 1-8). Glencar continued its exploration of several properties near the Wassa Mine and by yearend 2000 had announced the discovery of gold mineralization—at the Ballyebo prospect, which is 2 km southwest of the Wassa Mine, and at the Bawdia Bosso prospect, which is 2 km west of the Wassa Mine (Glencar

Mining plc., December 12, 2000, Gold found on second exploration target at Wassa, accessed May 2, 2001, at URL http://www.glencarmining.ie/press/2000.htm).

BGL operated the Bogosu Mine and the CIL plant, which were located between Prestea and Dunkwa. During its first full year of operation by the new owners Golden Star Resources Ltd. of Canada and Anvil Mining NL of Australia, BGL, which struggled with low gold prices and poor recovery rates, produced 3,378 kg of gold; this was a decrease of 17% compared with that of 1999. The decreased output in 2000 was attributed to lower gold recovery and lower throughout of transitional ores through the mill. Gold recovery rates declined to 64.4% from 81.4% in 1999. In April 2001, Golden Star bought out Anvil's 20% interest in BGL in exchange for 3 million shares of Golden Star stock, which was valued at $1.2 million. Mining operations at Bogosu were scheduled to end by mid-2001; milling operations would continue into early 2002 using stockpiled ore. Golden Star was conducting a feasibility study on developing a sulfide mining operation at Bogosu that was scheduled for completion in early 2001 and also negotiating with Barnato Exploration Ltd. and the Prestea Mine's employee group Prestea Gold Resources Ltd. to acquire the old Prestea mine property, which adjoins the southern boundary of the Bogosu mining lease. The Government's abrogation of Barnato's rights to mine at Prestea late in 2000 added a complication to the negotiations (Golden Star Resources Ltd., April 19, 2001, Golden Star announces 2000 yearend and fourth quarter financial results, Press Release, accessed May 2, 2001, at URL http://www.gsr.com/pr190401.html). Golden Star reported proven and probable oxide and transition (mixed oxide and sulfide) ore reserves as of December 31, 2000, using a $280 per troy ounce gold price, to be 2.46 Mt at a grade of 2.2 g/t gold. In addition, estimates of additional mineralized material, which were based on a gold price of $300 per troy ounce, included 1.95 Mt of oxide and transition resources at a grade of 1.95 g/t and 11.3 Mt of sulfides at a grade of 3.4 g/t gold (Golden Star Resources Ltd., 2001, p. 5-6).

During 2000, Bonte Gold Mines Ltd. (owned by Akrokeri-Ashanti Gold Mines Inc. of Canada) increased production by 41% to 2,134 kg of gold from the small alluvial mining operation on the Jeni River. Production was forecast to reach more than 2,364 kg of gold in 2001. Bonte's proven and probable ore reserves were estimated, as of January 1, 2001, to be about 7,200 kg of contained gold; significant exploration potential was located in 4 million cubic meters of gold-bearing gravels identified at the nearby Jeni property during 2000 (Akrokeri-Ashanti Gold Mines, Inc., March 14, 2001, Akrokeri-Ashanti announces results of 2000 exploration program on Jeni property, accessed May 11, 2001, at URL http://www.aagm.com/press/14%20Mar%2001_pf%20press_release.htm).

Normandy Ghana [owned by Normandy Mining Ltd. of Australia (90%)] continued to progress with exploration and feasibility work on its Yamfo-Sefwi project. The project was located in the Yamfo-Sefwi greenstone belt in west-central Ghana near Sunyani and Kenyasi about 60 km east of the border with Côte d'Ivoire. Normandy Mining reported mineral resources, as of June 30, 2000, to be 42.2 Mt of measured resources at a grade of 2.3 g/t, 16.8 Mt of indicated resources at a grade of 2.2 g/t, and 16.7 Mt of inferred resources at a grade of 2.0 g/t gold. In addition, the company held a 42.3% joint-venture interest in Moydow Mines International Inc.'s adjacent Area E (Ntotoroso) property where inferred resources were reported to be 14 Mt at a grade of 2.6 g/t gold. The two deposits have a combined gold content of 205,600 kg (6.61 million troy ounces). The completed feasibility study on the Yamfo-Sefwi project estimated that capital costs of $152 million would be required to develop 15 pits at Bosumkese, Kenyase, Subenso, and Yamfo and a treatment plant with an initial capacity of 3.5 Mt/yr, which would process oxide (40%) and sulfide (60%) ore. The plant flowsheet incorporated primary crushing, semiautogenous grinding, and ball milling followed by a CIL circuit. A feasibility study to incorporate Moydow's Ntotoroso deposit, which was based on toll processing of Ntotoroso ore at the Yamfo-Sefwi treatment plant and an increase in plant capacity to 5 Mt/yr of ore, was expected to be completed by mid-2001 (Normandy Mining Ltd., 2000, p. 15-17). In April 2001, Normandy received approval for a mining lease for Area E from the Government and signed an agreement with Franco-Nevada Mining Corp. Ltd., which would give Franco-Nevada a 19.9% equity interest in Normandy.

Chirano Gold Mining Ltd. [owned by Red Back Mining NL of Australia (95%)] continued exploration drilling at its Chirano property, which was located adjacent to the GBC bauxite mine at Awaso. Indicated mineral resources were reported to be 13.8 Mt at a grade of 2.3 g/t gold in seven prospects along 4 km of the Chirano Shear Zone at Akota extension, Akota North, Obra Paboase, Sariehu, Suraw, and Tano. Additional inferred mineral resources were estimated to be 5.31 Mt at a grade of 2.1 g/t gold (Red Back Mining NL, 2000, 2000 Red Back Mining NL annual report, accessed May 12, 2001, at URL http://www.redbackmining.com.au/). Feasibility studies completed during 2000 were based on a $300 per ounce gold price and on mining 1.5 Mt/yr of ore to produce 3,515 kg/yr of gold during a 6.6-year mine life. In early 2001, Ashanti made an offer to buy Chirano, which was rejected by Red Back as too low. Ashanti was seeking the Chirano ore as feed for its nearby Bibiani plant, which will run out of mine feed in late 2003. Subject to locating stand-alone financing or negotiating a better offer from Ashanti, Red Back was concentrating on expanding the gold resource base with further exploration at Chirano in 2001 (Red Back Mining NL, 2000; Red Back Mining NL, March 2001, Quarterly report, accessed May 12, 2001, at URL http://www.redbackmining.com.au).

Manganese.—Ghana Manganese Company Limited's Nsuta-Wassaw open pit mine near Tarkwa was the only producer of manganese ore in Ghana. Benefitting from recent investment in upgrading mining equipment and optimizing mine plans, production of manganese ore increased to 895,669 t of manganese ore from 638,937 t in 1999. The metal content of the ore was between 32% and 34% manganese.

Industrial Minerals

Cement.—Ghana Cement Works Ltd. (Ghacem) operated the country's only two cement plants at the port cities of Takoradi and Tema. Each plant had the capacity to produce 1.2 Mt/yr of cement by using imported clinker, gypsum, and limestone. During 1999, Heidelberg Zement AG of Germany acquired a 94.5% interest in Ghacem from Scancem International AG of Norway (60%) and the Government. The company operated essentially as a monopoly but faced increasing competition from cement imported from Togo in 1999 and 2000.

Diamond.—The majority of diamond was recovered by artisanal miners from alluvial and raised terrace gravel workings in the Birim Valley. On the basis of sales to the Precious Metals Marketing Corporation in 2000, artisanal output was reported to be 686,551 carats with an average sales value of $16.88 per carat. Production from Ghana Consolidated Diamonds Ltd.'s Akwatia diamond mine was not available for 2000; in 1999, however, 205,025 carats with an average sales value of $19.80 per carat was produced. Akwatia is located about half way between Accra and Kumasi and was the only formal operating diamond mine in Ghana.

Other Industrial Minerals.—Carmeuse Lime Products (Ghana) Ltd. (owned by Carmeuse S.A. of Belgium) operated out of Sekondi and produced limestone and lime, as well as seashells, which were supplied to Ashanti for use in its BIOX gold-treatment plant at Obuasi. The Ministry of Mines estimated that from 20,000 to 30,000 people were involved in the small-scale production of industrial minerals, which included kaolin, limestone, salt, and sand and gravel.

Mineral Fuels

In 1999, GNPC produced an estimated 6,000 barrels per day (bbl/d) of crude oil from the Saltpond field. In March 2000, Dana Petroleum plc and GNPC announced the discovery of oil in the offshore Western Tano Contract Area with a flow rate of up to1,000 bbl/d (U.S. Energy Information Administration, June 2000, Ghana—Oil, accessed October 12, 2000, at URL http://www.eia.doe.gov/emeu/cabs/ghana.html).

Ghana's only petroleum refining facility was the 45,000-bbl/d Tema oil refinery outside of Accra. It was operated by Tema Oil Refinery Co. (TOR) (a subsidiary of GNPC). TOR primarily processed imported Bonny Light/Brass River crudes from Nigeria and produced a variety of refined products for domestic consumption and export. In 1997, TOR's refining capacity was expanded to 45,000 bbl/d from 25,000 bbl/d. In February 1999, GNPC signed a $185 million contract with the Republic of Korea's Samsung Group to build a residual fluid cracking tower at TOR. The project was scheduled to be completed in 2002 and will help boost TOR's production of gasoline and distillates. GNPC also planned to conduct a feasibility study on the construction of a cogeneration plant at TOR. The project, which may be developed as an independent powerplant, will be fueled by gas, which, as of 1999, was being flared at the facility. The size of the plant will be determined by the study, and any excess power generated would be sold to the national grid (U.S. Energy Information Administration, June 2000, Ghana—Refining and downstream oil activities, accessed October 12, 2000, at URL http://www.eia.doe.gov/emeu/cabs/ghana.html).

In a major example of West African regional cooperation and good economic planning, a plan was put in place to use Nigerian natural gas, which is currently (2000) being flared, to help solve the long-term energy needs of the neighboring states of Benin, Ghana, and Togo. By using Nigeria's more-than 40 trillion cubic feet of natural gas reserves, a consortium led by Chevron Nigeria Ltd. has committed to build the West African Gas Pipeline by 2002. The $400 million project will involve the construction of an 800-km offshore gas pipeline from the Niger Delta to the west coast city of Effuasi, Ghana. The pipeline will supply an initial amount of 120 million cubic feet per day of gas to existing and planned powerplants in Benin, Ghana, and Togo. Cooperators in the West African Gas Pipeline Project include Nigerian National Petroleum Corporation, GNPC, Shell Petroleum Development Company, Société Togolese de Gaz, and SA Société Béninoise de Gaz (Chevron Nigeria Ltd., August 16, 1999, Chevron named project manager for west African gas pipeline project, accessed August 17, 1999, via URL http://www.chevron.com/newsvs/frame.html; allAfrica.com, November 13, 2000, West African gas pipeline co-operating for energy security, accessed January 20, 2001, at URL http://allafrica.com/stories/200011130108.html).

In February 1999, the Government announced plans for a new power system development policy to eliminate the power outages that plagued the economy in 1998. The plan called for Government involvement in joint-venture projects and in expediting licensing of private sector power projects. In 1999, construction began on the joint-venture project with the VRA to add 330 megawatts (MW) to the Takoradi thermal power complex, which will be completed between 2000 and 2001. GNPC also commissioned construction of a 125-MW power barge facility and associated transmission lines financed by the Japanese Government. Other power-generation projects included a joint venture that involved the Electricity Corporation of Ghana in restoring 80 MW of generation capacity and upgrading the distribution network within the Tema industrial estate before yearend 2000 and the 220-MW independent thermal power project being sponsored by the mining companies to assure themselves of long-term reliable power supply, particularly for the bauxite, gold, limestone, and manganese industries.

Outlook

Despite a favorable political and investment climate, the prospects for continued development of the key mining sector of the Ghanaian economy were threatened by continued weak commodity prices, particularly for gold in 1999 and 2000, and by high energy costs. Weak gold and cocoa prices have reduced the foreign exchange generation capacity of the country and began to slow the economy in 2000. Owing to periodic droughts, domestic energy supply, especially hydroelectric power, has been a problem, particularly for the aluminum industry and the expanding needs of the gold industry. Although new gas-fueled powerplant developments will help mitigate this problem, the long-term solution rested with implementation of the West Africa Gas Pipeline.

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TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity 2/		1996	1997	1998	1999	2000
Aluminum:						
Bauxite, gross weight		473	504	442	355 r/	504
Metal, smelter, primary		137	152	56	104	142
Arsenic, trioxide 3/	metric tons	5,443	4,577	5,000 e/	7,000	-- e/
Cement, hydraulic 4/		1,500 e/	1,700 e/	1,630 r/	1,870	1,950
Diamond:						
Gem e/	thousand carats	572	664	649	544	736
Industrial e/	do.	143	166	160	136	184
Total 5/	do.	715	830	809	680 r/	920 e/
Gold 6/	kilograms	49,211	54,662	72,541	79,946 r/	72,080
Manganese:						
Ore, processed		448	437	537	639 r/	896
Mn content e/		152	149	172	204 r/	287
Petroleum:						
Crude	thousand 42-gallon barrels	2,600	2,600	2,190	2,190	2,200
Refinery products: e/						
Liquefied petroleum gas	do.	365 7/	350	-- r/ 7/	625	625
Gasoline	do.	3,285 7/	3,300	1,460 r/ 7/	5,850	5,850
Jet fuel	do.	365 7/	350	365 r/ 7/	625	625
Kerosene	do.	1,095 7/	1,100	730 r/ 7/	1,950	1,950
Distillate fuel oil	do.	2,555 7/	2,500	1,460 r/ 7/	4,450	4,450
Residual fuel oil	do.	730 7/	700	1,460 r/ 7/	1,250	1,250
Other including refinery fuel and losses e/	do.	730 7/	700	1,825 r/ 7/	1,250	1,250
Total	do.	9,490 7/	9,000	7,300 r/ 7/	16,000	16,000
Salt e/		50	50	50	50	50
Silver, content of exported dore e/	kilograms	2,460 r/	2,730 r/	3,630	3,950	3,630
Steel, secondary, rebar e/		25	75 r/	75 r/	75	75

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through April 2001.

2/ In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are produced, as are limestone and lime for processing of some gold ore, and salt. Output of these commodities is not reported and information is inadequate to make reliable estimates of output levels.

3/ Reported data from Ashanti Goldfields Co. for 1996-97. Bogosu gold ore roaster closed in 1996. AGC-Obuasi roaster closed in June 2000.

4/ All from imported clinker.

5/ Production, in thousand carats, includes that of Akwatia Mine (1996--271; 1997--300 (estimated); 1998--252; 1999--205; 2000--233. Remainder are artisanal sales to the Precious Metals Marketing Corp. Estimates of unreported artisanal production are not included.

6/ Does not include estimate of smuggled or undocumented production.

7/ Reported figure.

TABLE 2
GHANA: STRUCTURE OF THE MINERAL INDUSTRY IN 2000

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	thousand metric tons	Volta Aluminum Co. Ltd. (Kaiser Aluminum & Chemical Corp., 90%; Reynolds Aluminum Co., 10%)	Aluminum smelter at Tema	200.
Bauxite	do.	Ghana Bauxite Co. Ltd. (Alcan Aluminum Ltd., 80%; Government, 20%)	Bauxite mine at Awaso	500. 1/
Cement	do.	Ghana Cement Works Ltd. (Heidelberg Zement AG, 94.5%)	Clinker grinding plant at Takoradi	1,900.
Do.	do.	Do.	Tema	1,200.
Diamond	thousand carats	Ghana Consolidated Diamonds Ltd. (Government, 100%)	Placer mine at Akwatia	360.
Gold	kilograms	Ashanti Goldfields Co. Ltd. [Depositary Nominee, Inc. (Ashanti), 36.1%; Lonmin, Plc., United Kingdom, 31.5%; Government, 19%; other private, 13.4%]	Mines: Obuasi underground mine Iduapriem Mine Bibiani Mine Ayanfuri Mine	39,800. (28,000). (5,000). (5,000). (1,800).
Do.	do.	Abosso Goldfields Ltd. [Ranger Minerals Ltd. (Australia), 90%; Government, 10%]	Damang Mine near Tarkwa	9,000.
Do.	do.	Barnex (Prestea) Ltd. [Barnato Exploration Ltd. (South Africa, 90%; Government, 10%] (sold to employees in 1999)	Prestea underground mine (closed September 1998)	1,100.
Do.	do.	Bogosu Gold Ltd. (Golden Star Resources Ltd. (Canada), 90%; Government, 10%)	Open pit mine at Bogosu (oxide mining phasing out in 2001)	3,100.
Do.	do.	Bonte Gold Mines Ltd. (Akrokeri-Ashanti Gold Mines, Inc., Canada, 85%; Government, 10%; Buosiako Co. Ltd., 5%)	Placer mine at Jeni, 40 kilometers southwest of Kumasi	1,100.
Do.	do.	Dunkwa Continental Goldfields Ltd. (closed in 2000)	Offin River dredging operation along Ashanti and central regions border	175.
Do.	do.	Gold Fields (Ghana) Ltd. (Gold Fields of South Africa Ltd., 71.1%; Repadre Capital Corp., 18.9%; Government, 10%)	Tarkwa open pit mines and heap leach (full capacity planned by 2003)	11,820 (15,550).
Do.	do.	Midras Mining Limited	Asikam alluvial mine (closed 2000)	250.
Do.	do.	Prestea Sankofa Gold Ltd.	Prestea tailings retreatment operation	650.
Do.	do.	Resolute Amansie Ltd. [Resolute Ltd. (Australia), 90%; Government, 10%]	Obotan Mine 40 kilometers northwest of Obuasi	4,160, to 4,666 in future.
Do.	do.	Satellite Goldfields Ltd. (Wassa Holdings Ltd., 90%; Government, 10%)	Wassa Mine, 30 kilometers northeast of Tarkwa	3,730.
Do.	do.	Teberebie Goldfields Ltd. (Pioneer Group Inc., United States, 90%; Government, 10%)	Teberebie open pit mine near Tarkwa (closed in 2000)	8,000. e/
Limestone and lime		Carmeuse Lime Products (Ghana) Ltd. (Carmeuse S.A. of Belgium, 100%)	Sekondi	NA.
Manganese ore	thousand metric tons	Ghana Manganese Company Limited (Government, minority interest)	Open pit mine at Nsuta-Wassaw in western region	650 (processed ore).
Petroleum, crude	thousand barrels	Ghana National Petroleum Corp. (Government, 100%)	Saltpond field	2,190
Petroleum products	do.	Tema Oil Refinery Co. (Government, 100%)	Refinery at Tema	16,500 (crude input).
Steel	do.	Ferro Fabrik	Steel mill at Tema (secondary)	20 (rod, rebar, wire).
Do.	do.	Tema Steel Co. [subsidiary of Ghana Industrial Holdings Co. (Government, 100%)]	do.	25 (rebar).
Do.	do.	Wahome Steel Ltd. (private Taiwanese investors, 95%; Ghanaian investor, 5%)	do.	30 (rod, rebar, wire).

e/ Estimated. NA Not available.

1/ To double capacity to 1 million metric tons by 2001.

TABLE 3
GHANA: GOLD PRODUCTION BY COMPANY AND MINE

(Kilograms)

Company	Mine	1996	1997	1998	1999	2000
Abosso Goldfields Ltd.	Damang, open pit	--	--	8,421	9,446	9,881
Ashanti Goldfields Co. Ltd.	Ayanfuri, open pit 1/	1,717	1,807	1,440	1,382	1,130
Do.	Bibiani	--	--	4,719	8,146	8,513
Do.	Iduapriem, open pit 2/	3,669	4,560	4,828	5,092 r/	5,191
Do.	Asikam, alluvial (Midras Mining Ltd.) 3/	--	--	233	34	--
Do.	Obuasi, open pit and underground	26,761	26,687	27,537	23,113	19,937
Total		32,147	33,054	38,757	37,767	34,771
Barnex (Prestea) Ltd.	Prestea, underground 4/	1,062	1,011	600	894	--
Bogosu Gold Ltd. 5/	Bogosu, open pit	3,327	3,464	3,813	4,058 r/	3,379
Bonte Gold Mines Ltd.	Esaase and Jeni River, placer	668	879	1,093	1,515 r/	2,134
Dunkwa Continental Goldfields Ltd.	Dunkwa, placer 6/	173	118	37	1	--
Gold Fields (Ghana) Ltd.	Tarkwa, underground 7/	1,476	1,672	1,670	1,269	--
Do.	Tarkwa, open pit, 1998 startup	--	--	2,522	6,806	11,272
Obenemasi Gold Mines Ltd.	Konongo/Obenemasi, open pit	588	176	--	--	--
Precious Minerals Marketing Corp. 8/	Artisanal workings	2,913	3,331	1,873	2,302 r/	1,968
Prestea Sankofa Gold Ltd.	Prestea Sankofa, tailings 9/	540	626	467	373	371
Resolute Amansie Ltd.	Obotan, open pit	--	2,151	5,411	4,230 r/	4,199
Satellite Goldfields Ltd.	Wassa, open pit, 1999 startup	--	--	--	2,712 r/	3,266
Teberebie Goldfields Ltd. 10/	Teberebie, open pit	6,317	8,180	7,877	8,573	839
Grand total		49,211	54,662	72,541	79,946	72,080

r/ Revised. -- Zero.

1/ Acquired in purchase of Cluff Resources in 1996; 1,659 kilograms attributed to Ashanti in 1996.

2/ Acquired in merger with Golden Shamrock in 1996; 590 kilograms attributed to Ashanti in 1996.

3/ Sold by Ashanti in 1999 and closed in 2000.

4/ Acquired by Barnex (Prestea) Ltd. (JCI Ltd. of South Africa) from State Gold Mining Corp. (SGMC) in 1996.

5/ Acquired by Golden Star Resources Ltd. (U.S.), 70%, and Anvil Mining NL (Australia), 30%, in 1999.

6/ Acquired from SGMC in 1995.

7/ Acquired by Gold Fields Ltd. of South Africa from SGMC in 1993.

8/ Includes 8 to 110 kilograms per year of byproduct gold from Ghana Consolidated Diamonds Ltd.'s Akwatia Mine. Includes gold purchases from small-scale miners by Miramex and other licensed buying authorities.

9/ Acquired by Ashanti in purchase of SAMAX, Inc. in 1998; sold in 1999. Included in Ashanti's total for 1998.

10/ Acquired by Ashanti (ore reserves) and Gold Fields (heap-leach facilities) in mid-2000.

Sources: Ghana Minerals Commission and Ghana Chamber of Mines.

THE MINERAL INDUSTRIES OF

KENYA AND UGANDA

By Thomas R. Yager

KENYA

The mineral industry in the East African country of Kenya has been chiefly noted for its production of fluorspar, salt, and soda ash. Other industrial minerals produced in recent years have included barite, diatomite, feldspar, gypsum, lime, silica sand, and vermiculite. Building materials produced have included cement, coral, granite, limestone, marble, and shale. Kenya has produced small amounts of metal products, which have included gold and secondary aluminum, lead, and steel. The country also has produced carbon dioxide, gemstones, and refined petroleum products.

In 2000, Kenya's gross domestic product (GDP) fell by 0.3% after rising by 1.4% in 1999 and 1.8% in 1998. Manufacturing accounted for 13.1% of the GDP; building and construction, 2.4%; and mining and quarrying, less than 1%. In 2000, the manufacturing and building and constructions sectors contracted by 1.5% (Central Bank of Kenya, 2001, p. 43-46). In 2000, Kenya's GDP amounted to $45.6 billion at purchasing power parity. Per capita GDP at purchasing power parity was $1,500 in 2000 (U.S. Central Intelligence Agency, 2001a).

Commodity Review

Metals

Gold.—Numerous deposits of gold occur in Kenya. Resources at the Migori deposit were estimated to be 1.6 million metric tons (Mt) at a grade of 4.3 grams per metric ton gold. Other deposits were found in greenstone belts in western Kenya. International Gold Exploration AB (IGE), an exploration and mining company based in Sweden, had projects in northwestern and southwestern Kenya. The company increased gold production at its small scale plant in Lolgorien, which was fed with ore from the Teng Teng Mine. IGE has identified eight additional areas nearby with gold potential (Opiyo-Akech, 2000).

Lead.—Although Kenya's only lead mine stopped production in 1996, the country continued to produce secondary lead (table 1). Production of lead amounted to about 1,000 metric tons per year (t/yr), and consumption, 3,000 t/yr (International Lead and Zinc Study Group, 2001, p. 6, 8). Kenya imported lead from China, Malaysia, Nigeria, and South Africa.

Titanium and Zirconium.—Tiomin Resources Inc. held the licenses to four substantial deposits of mineral sands in southeastern Kenya that contain ilmente, rutile, and zircon. The Kilifi deposit has resources of 1,700 Mt that contain 18.7 Mt ilmenite, 1.7 Mt rutile, and 1.7 Mt zircon. Resources at the Mambrui deposit were estimated to be 700 Mt that contain 14 Mt ilmenite, 0.7 Mt rutile, and 0.7 Mt zircon. The Vipingo deposit has estimated resources of 500 Mt. The Kwale deposit has 200 Mt that contain 4.0 Mt ilmenite, 1.0 Mt rutile, and 0.6 Mt zircon; the ilmenite contains 49% titanium dioxide, and the rutile, more than 95% titanium dioxide (Tiomin Resources, 1999, p. 12; Africa Energy & Mining, 2000a).

Tiomin eventually planned to exploit all these deposits sequentially but decided to focus on the $137 million Kwale project first owing to its higher grades of economically recoverable minerals. Most of the minerals recovered will be exported. During the first 6 years, output would be more than 300,000 t/yr of ilmenite, 75,000 t/yr of rutile, and 37,000 t/yr of zircon (Africa Energy & Mining, 2000a). Production was expected to begin in the first quarter of 2003 if Tiomin obtained mining licenses in early 2001. In November 2000, parties opposed to the Kwale project on environmental grounds were allowed to apply for an order to stop the Government from awarding licenses to Tiomin. Tiomin's project continued to move forward while the Government considered the petition (Africa Mining Intelligence, 2000).

Industrial Minerals

Cement.—From 1996 to 2000, Kenya's cement production fell by nearly one-half owing to the country's economic difficulties and decreasing export demand. In 2000, cement production fell to 1.07 Mt from 1.2 Mt in 1999, and cement consumption fell to 907,000 metric tons (t) from 1.01 Mt (Central Bank of Kenya, May 2001, Economic growth and real sector activities— Building and construction, Monthly Economic Review, accessed June 11, 2001, at URL http://home.centralbank.go.ke/ MonthlyReviews/ ShowReview.asp?DocumentID=1133). Exports declined to 283,682 t in 1999 from 472,148 t in 1995; about 34% of Kenya's cement was exported from 1995 to 1999. In 1999, France accounted for 40.5% of cement exports; Uganda 39.7%; and Comoros, 10.1%. The value of exported cement amounted to about $18 million in 1999 compared with $34.3 million in 1995 (Opiyo-Akech, 2000; International Trade Center and United Nations Statistics Division, 2001).

Bamburi Cement Ltd. was the largest cement producer in Kenya; its plant was the second largest in Sub-Saharan Africa with a capacity of 1.3 million metric tons per year. East African Portland Cement Co. Ltd. and Athi River Mining Ltd. (ARM) also produced cement (International Cement Review, p. 185).

Diatomite.—Numerous deposits of diatomite occur in the Rift Valley. Small amounts of high-grade diatomite were produced at Soysambu and Kariandusi near Gilgil for domestic and export markets (Opiyo-Akech, 2000).

Fluorspar.—Deposits of fluorspar occur in the Keiro Valley. The resources of these deposits amounted to about 5 Mt at an average grade of about 40% CaF_2 (Kendall, 1997; Miller, 2001). Fluorspar resources were exploited by Kenya Fluorspar Ltd. Exports increased to 83,658 t at a value of $7.5 million in 1999 from 56,202 t at a value of $4.7 million in 1995. From 1995 to

1999, Kenya exported about 85% of its fluorspar production, which was mostly used in the manufacture of hydrofluoric acid. In 1999, the Netherlands accounted for 19.3% of exports; the United States, 18.6%; the United Kingdom, 16.2%; India, 12.5%; Italy, 12.4%; and Greece, 10% (Opiyo-Akech, 2000; International Trade Center and United Nations Statistics Division, 2001). Domestic consumers of fluorspar included the cement and glass industries.

Gemstones.—Kenya was a producer of numerous gemstones, such as amethyst, aquamarine, cordierite, green garnet, ruby, sapphire, and tourmaline (table 1). In recent years, the country has produced amethyst from Mbooni Hill; aquamarine from Embu and Nachola; garnet from Lokirima, Mgama-Mindi, and Taita Taveta; ruby from Mangari, Taita Hills, and Thika; sapphire from Don Dol, Kinyiki Hill, Kubi Kano, Samburu, and Thika; and tourmaline from Magadi, Mgama-Mindi, and Osarara (Shigley and others, 2000, p. 311, 313-315, 317, 320, 322).

The largest companies involved in Kenya's gemstone industry were Bridges Exploration Ltd., Gemkit Enterprises Ltd., and Rockland Kenya Ltd. The value of official gemstone exports amounted to about $3.9 million in 1999; this figure probably represented a small percentage of actual exports owing to the smuggling of gemstones from Tanzania through Kenya. Although a small gem-cutting industry has developed, most of Kenya's gemstone exports were rough stones. In 1999, the value of unworked gemstone exports amounted to $2.9 million, and worked gemstone exports, about $1 million. India accounted for 55.1% of Kenya's gemstone exports; Thailand, 10.5%; the United States, 9.3%; and Germany, 8.5% (Opiyo-Akech, 2000; International Trade Center and United Nations Statistics Division, 2001).

Kaolin and Other Clays.—Deposits of kaolin were found in the Nyeri district north of Nairobi. The kaolin resources at Gaithita were estimated to be 10 Mt, and at Karundu, 5 Mt to 10 Mt (Notholt, 1993, p. 184). ARM produced small amounts of kaolin for use in ceramic tiles, paper, paint, and rubber products. The company also mined bentonite at Ndulutu and china clay at Karatina (Athi River Mining Ltd., 2000, Profile—Plants & mining locations, accessed June 11, 2001, at URL http://www.armkenya.com/subsection.php?subsection_id=43&title=Plants+%26+Mining+Locations&section_id=3&). In 1999, Kenya imported 5,022 t of bentonite, kaolin, and other clays, which was an increase from 4,282 t in 1995. The country also exported small amounts of kaolin (International Trade Center and United Nations Statistics Division, 2001).

Limestone.—Large deposits of dolomite, limestone, and marble occur widely in Kenya. Resources from a limestone deposit near Bamburi and Mombasa were estimated to be more than 50 Mt; these resources were exploited by Bamburi Cement. ARM exploited the resources of the Kajiado deposit southwest of Nairobi and the Kaloleni deposit near Mombasa for use in the Kaloleni cement and lime plant. Resources of travertine from the Umani Crater were estimated to range from 35 to 50 Mt. Marble resources at Mutini were estimated to be 23 Mt (Bosse, 1996, p. 186, 193-194). About 32,000 t/yr of limestone was used for dimension stone (table 1).

Kenya's exports of lime increased to 7,872 t in 1999 from 6,932 t in 1995; during the same period, the value of exports fell to $545,000 from $658,000. In 1999, Uganda accounted for 74.6% of lime exports, and Tanzania, 24.2% (International Trade Center and United Nations Statistics Division, 2001).

Salt.—Lake Magadi, which is in the Great Rift Valley, contains notable resources of salt. Magadi Soda Ash Co. Ltd., which was the largest salt producer in Kenya, extracted salt as a byproduct of the soda ash production process. Other salt producers included Krystalline Salt Ltd., Mombasa Salt Works Ltd., and Salt Manufacturers Kenya Ltd.

Salt exports increased to 120,331 t in 1999 from 100,334 t in 1995, although their value fell to $9.9 million from $12 million. In 1999, Uganda accounted for 63.5% of Kenya's salt exports; Rwanda, 15%; Tanzania, 9.3%; and the Democratic Republic of the Congo [Congo (Kinshasa)], 8.8%. From 1995 to 1999, salt imports fell to 27,802 t from 38,602 t, and their value fell to $1.1 million from $3.7 million. In 1999, about 71% of Kenya's salt imports came from South Africa, and 22%, from Jordan (International Trade Center and United Nations Statistics Division, 2001).

Silica Sand.—ARM exploited deposits of silica sand that occurred at Kaloleni. Silica sand has been used by such Kenyan companies as Central Glass Industries Ltd. to manufacture glass bottles and containers. The value of glass imports fell to $13.2 million in 1999 from $14 million in 1995. Kenya imported more than 17,000 t of glass in 1999; imports of float, ground, and polished glass amounted to 13,615 t (International Trade Center and United Nations Statistics Division, 2001). The country also exported small amounts of glass.

Soda Ash.—Substantial resources of trona occur at Lake Magadi. Kenya's trona resources were estimated to be 12.6 Mt, or about 7 Mt of soda ash (Kostick, 2001). Magadi Soda Ash was Kenya's only soda ash producer. Exports increased to 214,429 t in 1999 from 210,805 t in 1995; about 89% of Magadi's production was exported during this period. The value of exported soda ash fell to $18.8 million in 1999 from $20.7 million in 1995. In 1999, Thailand accounted for 35.1% of soda ash exports; India, 23.9%; the Philippines, 11.7%; Indonesia, 7.5%; and South Africa, 4.3% (Opiyo-Akech, 2000; International Trade Center and United Nations Statistics Division, 2001). Domestic consumers of soda ash included the caustic soda, detergent, and glass industries.

Sulfur.—Kenya's known deposits of sulfur are small and uneconomic. The country, however, produced about 20,000 t/yr of sulfuric acid for domestic consumption from imported sulfur (table 1). In 1999, Kenya imported 8,042 t of sulfur from Saudi Arabia, Iran, and other countries at a value of $988,000 (International Trade Center and United Nations Statistics Division, 2001).

Mineral Fuels

Kenya did not produce crude petroleum and relied on imports for its refinery. Imports of crude petroleum fell to about 8.31 million barrels (Mbbl) in 1999 from 9.96 Mbbl in 1995. In 1999, the value of imported crude petroleum was $158.4 million, which was a significant decrease from that of $232.9 million in 1995. The United Arab Emirates accounted for 90% of Kenya's crude petroleum imports, and Iran, 10% (International Trade Center and United Nations Statistics Division, 2001).

The value of imported petroleum products increased to

$265.6 million in 1999 from $167.4 million in 1995. Bahrain, Saudi Arabia, and South Africa were the principal sources of Kenya's imported petroleum products. The value of exported petroleum products increased to $135.8 million in 1999 from $102.1 million in 1995. Uganda accounted for about 60% of exports; Rwanda, 13%; and Tanzania, 11% (International Trade Center and United Nations Statistics Division, 2001). Kenya Petroleum Refinery Ltd., which was the country's only refinery, had a capacity of 90,000 barrels per day but has produced only at about 40% capacity in recent years (table 1).

Exploration for petroleum continued in 2000. The National Oil Corporation of Kenya, which was a state-owned company, has begun to review all the geological and geophysical data from the country's sedimentary basins. The company also signed three exploration contracts with the British company Star Petroleum.

In October 2000, Kenya and Uganda agreed to extend the pipeline linking Eldoret and Mombasa in Kenya to Kampala in Uganda. Work could begin in early 2002, but the cost needed to be reassessed. The pipeline would also serve Burundi, Congo (Kinshasa), and Rwanda (Africa Energy & Mining, 2000b).

Infrastructure

Although Kenya had an installed electric power capacity of 1,041 megawatts (MW), actual capacity has been about 600 MW. Hydroelectric plants account for about 75% of installed capacity, thermal, 15%, and geothermal, 10%. A prolonged drought has severely reduced Kenya's ability to generate hydroelectric power. Peak demand exceeded 700 MW of capacity; the resulting power shortages were a significant factor in the country's weak economic performance in the past 3 years (U.S. Embassy, Nairobi, Kenya, 2000). The shortages would have been significantly greater without increased imports of electricity from Uganda.

The Government planned to reduce reliance on hydroelectric power. Two new thermal powerplants and one geothermal plant with a combined capacity of 153 MW were supposed to come on-line in 2000. In 2001, three additional plants were expected to provide an extra 180 MW. Reliance on hydropower was expected to drop to 55% by 2003 and 32% by 2017 (U.S. Embassy, Nairobi, Kenya, 2000).

Kenya had about 63,800 kilometers (km) of roads, of which approximately 8,900 km were paved; the rail network covered 2,700 km. Pipelines for petroleum products covered about 480 km. Lake Victoria was a major waterway for internal commerce. Ports and harbors were Kisumu, Lamu, and Mombasa (U.S. Central Intelligence Agency, 2000a). In August 2000, the Government announced its intention to privatize the container terminal at the major port of Mombasa.

UGANDA

In recent years, the East African country of Uganda has been known to produce cobalt, gold, limonite and other iron ore, niobium, steel, tantalum, tin, and tungsten. Uganda has also produced industrial minerals, such as apatite, gypsum, kaolin and other clays, lime, and salt, and building materials, such as cement, limestone, and pozzolanic materials.

During the fiscal year ending in June 2000 (fiscal year 1999-2000), Uganda's GDP rose by 5.1% after increasing by 7.4% in fiscal year 1998-99 and 5.4% in fiscal year 1997-98. In fiscal year 1999-2000, the construction sector grew by 8.5%; electricity and water, 11.1%; manufacturing, 8.6%; and mining and quarrying, 5%. From fiscal years 1995-96 to 1999-2000, the mining sector grew by 20.6% per year. In fiscal year 1999-2000, the manufacturing sector accounted for 10% of the GDP; construction, 8.1%; electricity and water, 1.1%; and mining and quarrying, 0.7% (Uganda Ministry of Finance, Planning & Economic Development, 2000, p. 9). The U.S. Central Intelligence Agency (2001b) estimated that Uganda's GDP amounted to $26.2 billion at purchasing power parity in 2000. Per capita GDP at purchasing power parity was $1,100.

Commodity Review

Metals

Cobalt and Copper.—The Kilembe cobalt and copper deposits have proven resources of more than 5 Mt at a grade of 1.7% copper and 0.18% cobalt (Tuhumwire, 1996; Uganda Ministry of Energy & Mineral Development, 2001a, p. A4.1). Resources from a stockpile of cobaltiferous concentrate at the abandoned Kilembe copper mine amounted to more than 900,000 t at a grade of 1.34% cobalt. The mine's tailings were estimated to contain an additional 5.5 Mt at a grade of 0.114% cobalt (Banff Resources Ltd., 1997a, b).

Kasese Cobalt Co. Ltd. (KCCL) recovered cobalt from the Kilembe stockpile through bioleaching and solvent extraction-electrowinning. The company also planned to recover cobalt from the tailings. KCCL was a joint venture between Banff Resources Ltd. of Canada and Kilembe Mines Ltd., which was owned by the Ugandan Government. In the fourth quarter of 2000, the Kasese plant operated at 53% of capacity and produced cobalt that averaged 99.8% purity (African Mining Bulletin, 2001). Problems with the bioleaching process and obtaining adequate power supplies caused the plant to operate at an unprofitably low capacity.

The value of cobalt produced in Uganda amounted to about $2.53 million in 1999 and $13.55 million in 2000. Exports amounted to 67 t at a value of $2.29 million in 1999 and 395 t at a value of $13.03 million in 2000 (Uganda Ministry of Energy & Mineral Development, 2001a, p. 38-40, A4.1). Uganda exported about 95% of its cobalt production in 1999 and 2000 (table 1).

Columbium (Niobium) and Tantalum.—Uganda's deposits of columbium and tantalum at Nyakasopu, Nyanga, and Rugomera were mined during the 1930s and 1960s. Small-scale production from reworking the Nyanga tailings resumed in 2000. Companies that held exploration licenses included Marubeg Co. Ltd., Shinda Ltd., and Sphere Resources Ltd. In 2000, the Canadian company Uganda Gold Mining Ltd. was evaluating the remaining resources. Additional resources of 6 Mt of pyrochlore occur at the Sukulu carbonatite deposit. The value of columbium and tantalum concentrates produced in Uganda amounted to about $13.56 million in 2000. Exports of columbium and tantalum concentrates amounted to nearly 70 t in 1999 (Uganda Ministry of Energy & Mineral Development, 2001a, p. 37, 39-40, A4.3, A5.4).

A report issued by the United Nations Security Council accused the Ugandan Government officials, military officers, and businessmen of illegally exploiting columbium, diamond, gold, and tantalum from Congo (Kinshasa) to enrich themselves and to finance their country's military presence in Congo

(Kinshasa). The Ugandan Government denied the accusations. Others accused of using their military presence to exploit Congolese mineral resources included rebel forces operating in Congo (Kinshasa) and the Governments of Namibia, Rwanda, and Zimbabwe (United Nations Security Council, 2001a, p. 16-21, 25, 29-37; 2001b, p. 6-11, 16-23).

Gold.—Numerous deposits of gold were found in Uganda. In 2000, several gold exploration companies had prospecting licenses granted or renewed; these included Anglo-Ugandan Corporation plc and Nabisoga Mining Ltd. in the Mubende district and New Ensign Resources Ltd. and Roraima Mining Company Ltd. in the Busia district. Other companies that held prospecting or mining licenses in 2000 included Busitema Mining CIE Ltd. in the Tororo district, Gold Empire Ltd. in the Bushenyi and the Mbarara districts, Lincoln Resources Ltd. in the Busia district, and Muhindo Enterprises in the Bushenyi district. The value of gold produced in Uganda amounted to $477,000 in 2000. Exports amounted to 7,303 kilograms (kg) with a value of $62.23 million in 2000 compared with 5,558 kg with a value of about $51.87 million in 1999 (Uganda Ministry of Energy & Mineral Development, 2001a, p. 38-40, A5.1-A5.3, A5.8).

Iron Ore and Steel.—Uganda's deposits of iron ore were located at Kyanyamuzinda, Metuli, Mugabuzi, Muko, Sukulu, and Wambogwe. Resources at Sukulu were estimated to be 45.7 Mt at an average grade of 62% iron. The Muko deposit has resources of 30 Mt at a grade of 61% to 67% iron. The Kyanyamuzinda deposit has resources of 2.37 Mt of ore, and the Wambogwe deposit, 2 Mt of ore (Uganda Ministry of Energy & Mineral Development, 2001a, p. A4.2). Resources at Mugabuzi totaled 1 Mt of ore indicated and 0.8 Mt of ore inferred (Uganda Investment Authority, 2001b, p. 6).

The Muko deposit was worked by artisanal miners. In January 2000, the Muko Iron Ore Development Co. Ltd. (MIDECO) was developed to exploit the Muko deposit on a commercial basis. MIDECO planned to use the direct reduction process to produce sponge iron that could be used in the Ugandan steel industry. The company was considering the use of Tanzanian coal in the production process (Opio, 2000). Exploitation of Muka and other iron deposits would allow Uganda to meet its rapidly increasingly demand for steel products. Uganda's demand for steel products was estimated to be 80,000 t/yr, but production was only 7,000 t/yr (table 1). Demand was expected to grow at an annual rate of about 10% from 2000 to 2005. Substantial increases in domestic production could deplete the national steel scrap bank in 3 to 5 years (Uganda Investment Authority, 2001b, p. 9).

Tin.—Numerous deposits of tin occur in Uganda. Edith Krall Investments Ltd. held a mining license for the Kyamugashe deposit in the Ntungamo district. Uganda's production of tin was limited by weak local demand.

Tungsten.—Deposits of wolframite occur at Bahati, Buyaga, Kirwa, Mpororo, Nyamulilo, Ruhizha, and Rushanga. Total inferred resources were estimated to be 20 Mt at a grade of 1% to 4% WO_3. Krone Uganda Ltd. held a mining license for the Nyamulio deposit, where production was small scale in 2000. Other companies that held tungsten mining licenses included Kirwa Wolfram Mines Ltd. and Ruhihza Mines Ltd. Exports of tungsten ore amounted to 78 t in 2000 and 35 t in 1999 (Uganda Ministry of Energy & Mineral Development, 2001a, p. 40, A4.4, A5.7-A5.8).

Industrial Minerals

Cement.—Uganda's cement production sharply increased in recent years (table 1) owing to rapid growth in the construction sector. Cement was exported to Congo (Kinshasa), Rwanda, and Tanzania. Uganda imported cement and clinker from India, Indonesia, Japan, and Kenya. Housing accounted for 45% of the demand for cement; infrastructure and public works, 20%; and industry, 15% (International Cement Review, 2001, p. 296).

Two local factories supplied Uganda's cement market. Hima Cement Industries Ltd., which was located in southwestern Uganda, exported an estimated 15% to 18% in 2000 and 13% of its sales in 1999. Tororo Cement Industries Ltd. was engaged in capacity expansion that was designed to increase production by about 37,000 t/yr (International Cement Review, 2001, p. 296).

Clay.—Numerous deposits of brick clay are known to exist throughout Uganda. The most substantial resources occur at Kajansi and Namanve; resources at Namanve were estimated to be 855,000 t (Uganda Ministry of Energy & Mineral Development, 2001a, p. A4.1). The rapid expansion of the construction sector has led to increased demand for brick clay. Uganda's production of clay bricks and tiles increased to 32,504 t in 1999 from 15,817 t in 1995. The country's total production capacity for clay bricks and tiles was 50,000 t/yr. Clay and Allied Products, Kiwa Industries Ltd. AEF, and Uganda Clays Ltd. were involved in the production of bricks and tiles (Uganda Investment Authority, 2001a, p. 5, 24).

Gypsum.—Uganda has several notable gypsum deposits. The Muhokya gypsum deposit was estimated to contain 3.2 Mt of gypsiferous clays. Resources at Kibuku were estimated to be 1.2 Mt at a grade of 10% gypsum, and Mburo, 1.1 Mt at a grade of 60% to 70% gypsum (Uganda Ministry of Energy & Mineral Development, 2001a, p. A4.2). Although Uganda's gypsum resources have been used in the cement industry, most of the country's gypsum demand has been met by imports from Kenya in recent years.

Kaolin.—Deposits of kaolin were found at Buwambo, Kisai, Kilembe, Kuluva, Lunyenye, Mutaka, and Namasera. The Uganda Ministry of Energy & Mineral Development (2001a, p. A4.2) indicated that proven resources at Mutaka amounted to 760,000 t of kaolin. Muse Mining Co. Ltd. held a license for the Kisai deposit. At Buwambo, a local company mined and processed kaolin for use in manufacturing paint. Uganda's kaolin may also be used to manufacture floor and wall tiles in the future.

Limestone.—Uganda's deposits of limestone were used by the cement industry. Hima was the largest known deposit; resources were estimated to be more than 25 Mt. The Tororo Hill deposit has resources of 16.3 Mt; only 3 Mt is higher grade limestone. Resources at Bukiribo were estimated to be 4.8 Mt. Other deposits were found at Dura and Gweri Hill. Mining licenses were held by such companies as Busongora Lime Ltd., Hima Cement Industries, Rwenzori Lime Co. Ltd., Tororo Cement Industries, and Uganda Lime Products Ltd. The value of limestone produced amounted to about $12.73 million in 2000 and $6.48 million in 1999 (Uganda Ministry of Energy & Mineral Development, 2001a, p. 39, A4.3, A5.7-A5.8).

Marble.—Notable deposits of marble occur in Uganda. Resources at Forest Reserve amount to 5.7 Mt, and those at Tank Hill, 4.2 Mt. Other deposits occur at Katikekakile and Rupa. Rupa Investments & Technology, which held an exploration license in the Rupa area, conducted limited exploration activities in 2000. The Saudi Marble Company Ltd. held similar licenses in the Karamoja area, but was unable to explore because of regional instability (Uganda Ministry of Energy & Mineral Development, 2001a, p. 38, A4.3).

Phosphate.—Uganda has substantial resources of phosphate rock. The Sukulu deposit in Eastern Uganda has resources of 230 Mt at a grade of 13% P_2O_5, and the Bukusu deposit, 8.5 Mt at a grade of 13% P_2O_5 (Uganda Ministry of Energy & Mineral Development, 2001a, p. A4.4). The Government granted the French company Rhodia Chimie SA a license to mine phosphates from the Sukulu deposit. Local company Madhvani International SA will join Rhodia in the $300 million project. Rhodia and Madhvani hoped to produce 100,000 t/yr of phosphate fertilizers and 1 Mt/yr of phosphate rock. By 2005, the two companies planned to produce sodium tripoly phosphate detergent (Africa Energy & Mining, 2000c).

Pozzolanic Materials.—Deposits of pozzolanic materials in the Kabele and the Kisoro districts were exploited for use in pozzolanic cement by Hima Cement Industries. The value of pozzolanic materials produced amounted to about $414,000 in 2000 compared with $249,000 in 1999 (Uganda Ministry of Energy & Mineral Development, 2001a, p. 36, 39).

Salt.—Resources at Lake Katwe were estimated to be 22.3 Mt at a grade of 8% NaCl (Uganda Ministry of Energy & Mineral Development, 2001a, p. A4.1). A feasibility study funded by the African Development Bank recommended constructing a plant at Lake Katwe to produce 50,000 t/yr of table salt. Most of Uganda's salt has been imported in recent years.

Silica Sand.—Deposits of silica sand occur in the Masaka and the Mukono districts. In the Masaka district, the Bukakata, the Diimu, and the Kome Island deposits have a combined resource of more than 3 Mt. In the Mukono district, the Nalumuli deposit has resources of 200,000 t, and the Nyimu deposit, 5,000 t (Uganda Ministry of Energy & Mineral Development, 2001a, p. A4.1). Resources at the Bukakata and the Diimu deposits grade 99% to 99.3% SiO_2. The Government and private companies have studied the feasibility of using these sands to produce container glass, sheet glass, and tableware. Proposals included the revival of glass production at East African Glass Works Ltd. (Uganda Investment Authority, 1997). From 1995 to 1999, Uganda's imports of glass increased from $8 million to $8.2 million.

Vermiculite.—The Namekhela vermiculite deposit has resources of 5 Mt. A comprehensive environmental impact assessment of mining this deposit was conducted by Canmine Resources (U) Corp. (Uganda Ministry of Energy & Mineral Development, 2001a, p. 38, A4.4). In December 2000, the Government awarded a mining lease to Canmine, which planned to produce 40,000 t/yr of vermiculite and to export to European and Middle Eastern countries. The Namekhela vermiculite is a high-quality material well suited to insulation and horticultural applications (Industrial Minerals, 2001).

Mineral Fuels

Uganda did not have production facilities for crude petroleum or petroleum products. In 2000, Uganda consumed about 3.25 Mbbl of petroleum products, which was a modest decrease from 3.42 Mbbl in 1999. Consumption of gasoline amounted to 1.2 Mbbl; diesel, 1.17 Mbbl; kerosene, 353,000 barrels (bbl); jet fuel, 259,000 bbl; fuel oil, 220,000 bbl; lubricants; 30,000 bbl; liquified petroleum gas, 18,000 bbl; and asphalt, 3,300 bbl. Since 1995, the country has increased its consumption of petroleum products by 32% (Uganda Ministry of Energy & Mineral Development, 2001, Petroleum products consumption, accessed August 1, 2001, at URL http://www.energyandminerals.go.ug/pet_cons.htm). The value of imported petroleum products amounted to $139.25 million in fiscal year 1999-2000 and $107.78 million in fiscal year 1998-99 (Uganda Ministry of Finance, Planning & Economic Development, 2000, p. 32).

In July 1998, Heritage Oil and Gas Ltd. conducted a seismic survey of the Semliki Basin where it had found resources of petroleum. The company planned to drill on the shores of Lake Albert in late 2000. The Government indicated that geologic mapping in the Pakwach Basin has also obtained favorable results.

Infrastructure

Uganda's electricity production increased to 1,555 gigawatt hours (GWh) in 2000 from 1,342 GWh in 1999 and 1,057 GWh in 1995. After electricity losses of 461.3 GWh, domestic electricity sales amounted to 843 GWh, of which more than 99% came from hydroelectric power sources. Total installed capacity increased to 263 MW in 2000 from 183 MW in 1999. Although total electricity demand was 260 MW of capacity in 2000, peak demand was 280 MW of capacity. Uganda exported 251.3 GWh of electricity in 2000, which was a 44% increase compared with that of 1999 (Uganda Ministry of Energy & Mineral Development, 2001, Uganda electricity data, accessed August 1, 2001, at URL http://www.energyandminerals.go.ug/elec_cons.htm).

In December 2000, the African Development Bank granted the Uganda Electricity Board (UEB) a $25 million loan to help reduce the considerable power losses owing to inadequacies in the distribution grid and theft of transmission equipment. Total expenses needed to upgrade Uganda's distribution and transmission systems and keep up with power consumption growth of at least 7% per year were estimated to be $300 million. Uganda's hydroelectric capacity was expected to increase to 380 MW in 2002 and 630 MW in 2004 (Africa Energy Intelligence, 2000, 2001).

The UEB had contracts to sell Kenya 30 MW of capacity; Tanzania, 9 MW; and Rwanda, 5 MW. Exports of electricity to Kenya were suspended during peak consumption periods in Uganda. In 2000, Uganda discussed increasing the total capacity exported to Kenya, Rwanda, and Tanzania to 65 MW in 2005 and 80 MW in 2006 (Uganda Ministry of Energy & Mineral Development, 2001b, p. 10).

The Government of Uganda planned to privatize the UEB in 2001. The UEB would be split into three companies—one handling production; the second transmission; and the third marketing. Marketing and production would be open to competition, and the transmission network would remain under public control (Uganda Ministry of Energy & Mineral

Development, 2001b, p. 10).

The hydroelectric power potential of Uganda was estimated to be about 2,000 MW, most of which is on the Nile River. Geothermal resources were estimated at about 450 MW in the Ugandan Rift System (Uganda Ministry of Energy & Mineral Development, 2001b, p. 9, 16).

Uganda had about 27,000 km of roads, of which approximately 1,800 km were paved; the rail network covered about 1,240 km. Pipelines for petroleum products covered about 480 km. Lake Albert, Lake George, Lake Edward, Lake Kyoga, Lake Victoria, the Albert Nile, and the Victoria Nile were the country's principal waterways. Ports and harbors were Entebbe, Jinja, and Port Bell (U.S. Central Intelligence Agency, 2001b).

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TABLE 1
KENYA AND UGANDA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Country and commodity		1996	1997	1998	1999	2000 e/
KENYA 3/						
Aluminum, secondary e/		2,400	2,400	2,000	2,000	2,000
Barite e/		20	20	10	10	10
Carbon dioxide gas, natural		9,119	9,214	8,498	10,006	10,000
Cement, hydraulic	thousand tons	1,816	1,506	1,426 r/	1,204 r/	1,071 4/
Clays, kaolin e/		595 4/	500	500	500	500
Diatomite		415	297	468	507	500
Feldspar e/		100	100	100	100	100
Fluorspar (acid grade)		83,000	68,700	60,854	93,602	90,000
Gemstones, precious and semiprecious:						
Amethyst e/	kilograms	300	104 5/	166 5/	170	170
Aquamarine e/	do.	50	12 5/	15 5/	15	15
Cordierite (Iolite) e/	do.	15	19 5/	34 5/	30	30
Garnet e/	do.	120	18,181 5/	5,186 5/	5,000	5,000

See footnotes at end of table.

TABLE 1--Continued
KENYA AND UGANDA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Country and commodity	1996	1997	1998	1999	2000 e/
KENYA--Continued 3/					
Gemstones, precious and semiprecious--Continued:					
Ruby kilograms	1,200 e/	5,175	4,001	4,490	4,490
Sapphire e/ do.	2,300	615 5/	3,313 5/	3,300	3,300
Tourmaline do.	250 e/	6,969	3,790	3,800 e/	3,800
Gold, mine output, Au content do.	492 r/	440 5/	388 5/	990	990
Gypsum and anhydrite e/	1,000	1,000	1,000	1,000	980
Lead:					
Mine output, Pb content	5 e/	--	--	--	--
Refined, secondary	2,000	1,000	1,000	1,000	1,000 4/
Lime e/	15,000	15,000	16,000	15,000	15,000
Petroleum refinery products:					
Gasoline thousand 42-gallon barrels	2,555	2,555	2,555	2,550 e/	2,570
Jet fuel do.	2,190	2,190	1,825	1,810 e/	1,820
Kerosene do.	730	730	730	730 e/	740
Distillate fuel oil do.	3,285	3,285	3,285	3,270 e/	3,290
Residual fuel oil do.	3,650	3,650	3,650	3,650 e/	3,670
Liquified petroleum gas do.	365	365	365	360 e/	370
Other do.	730	730	730	730 e/	740
Total do.	13,505 r/	13,505 r/	13,140 r/	13,100 r/ e/	13,200
Salt, crude	41,000	6,280	21,742	44,886	44,900
Soda ash	223,000	257,640	242,910	245,680	246,000
Steel, crude e/ thousand tons	30	33	25	25	25
Stone, sand and gravel:					
Coral e/ do.	1,000	500	500	500	490
Granite for dimension stone e/	100	500 5/	1,619 5/	1,600	1,570
Limestone for cement thousand tons	600	700	700	700 e/	690
Limestone for dimension stone	31,935 r/	32,935 r/	32,000	32,000	31,500
Marble for dimension stone	100	966 5/	84 5/	100 e/	95
Sand, industrial (glass) e/	13,000	13,000	12,000	12,000	11,800
Shale e/	120,000	200,000	180,000	180,000	177,000
Sulfuric acid e/	20,000	20,000	20,000	20,000	20,000
Vermiculite	734	1,418	353	164	160
UGANDA 6/					
Cement, hydraulic	175,046 r/	289,560 r/	321,329 r/	347,274 r/	380,000
Cobalt	--	--	--	77	411 4/
Columbium-tantalum kilograms	-- r/	-- r/	-- r/	-- r/	2,712 4/
Gold, mine output, Au content do.	3 r/	6 r/	8 r/	5 r/	56 4/
Gypsum	2,281 r/	-- r/	2,000 e/	256	-- 4/
Iron ore:					
Limonite	NA	NA	NA	3,169	2,231 4/
Other	200	2,432	300 e/	61	2,401 4/
Kaolin	NA	NA	NA	198	14 4/
Lime, hydrated and quick e/	1,000	1,000	1,000	900	900
Limestone	159,479 r/	919,353 r/	300,000 e/	121,524 r/	253,032 4/
Phosphate minerals, apatite	--	--	(7/) e/	(7/) e/	(7/)
Pozzolanic materials	NA	NA	NA	20,213	35,603 4/
Salt e/	10	10	5	5	5
Steel e/	12,000	15,000	15,000	15,000	7,000
Tin, mine output, Sn content	(7/)	2 r/	1 r/	(7/)	(7/) 4/
Tungsten, mine output, W content kilograms	--	--	--	(7/) r/	-- 4/

e/ Estimated. r/ Revised. NA Not available. -- Zero.

1/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

2/ Includes data available through August 6, 2001.

3/ In addition to the commodities listed, a variety of minerals and construction materials [brick clays, coal, gravel, iron ore, kyanite, meerschaum, mica, murram (laterite), crushed rock, and construction sand] may be produced, but quantities are not reported, and information is inadequate to make estimates of output.

4/ Reported figure.

5/ Reported exports.

6/ In addition to the commodities listed, the following are presumably produced but information is inadequate to estimate output: clay, copper content of slag, corundum, garnet, gemstones, gravel, marble, ruby, sand, and vermiculite.

7/ Less than 1/2 unit.

THE MINERAL INDUSTRY OF

LESOTHO

By George J. Coakley

Lesotho, which is a landlocked, independent constitutional monarchy surrounded by South Africa, has long been known as a source of diamonds, mostly from alluvial deposits. Mineral production, however, has not been a significant part of the economy. Artisanal miners produced a small amount of clay, crushed stone, and sand and gravel for domestic consumption. Artisanal diamond production was around 1,500 carats per year. The nation supported a population of 2.1 million people in a 30,350-square-kilometer area. According to the World Bank (September 12, 2000, Lesotho at a glance, accessed February 27, 2001, via URL http://www.worldbank.org/data/country/countrydata.html), the country's gross domestic product (GDP) in 1999 was estimated to be $870 million.

Repatriated wages from Basotho miners who worked in the South African gold mines have historically contributed significantly to national income. In 1990, mine workers' remittances back to Lesotho contributed to about 67% of the GDP. This contribution dropped to 33% of GDP in 1996. The collapse of international gold prices and the resultant downsizing of the South African gold industry labor force, however, led to layoffs of substantial numbers of Basotho miners. Between 1989 and the beginning of 2000, the total number of Basotho workers employed in South African mines dropped from 129,000 to 64,000, and an additional 17,000 mine workers were expected to lose their jobs before yearend 2000 (Africa Newswire Network, May 3, 2000, Lesotho—More miners lose jobs, accessed April 1, 2001, at URL http://www.africanewswire.com/annews/categories/lesotho/story1867.shtml).

Commercial interest in the mineral resources of Lesotho was limited to diamonds. In recent years, 33 kimberlite pipes and 140 dikes, of which 24 are diamondiferous, have been identified by the Lesotho Geological Survey. Since 1996, Messina Diamond Corp. of Canada, whose name changed to MineGem Inc. in 2000, was exploring the Liqhobong kimberlite pipes, which are located about 120 kilometers east-northeast of the capital of Maseru. In Messina's 1999 annual report, the company disclosed the results of work on its two discoveries—the Main Pipe and the Satellite Pipe. The indicated resources were estimated to be 2.6 million metric tons (Mt) of ore at a grade of 69 carats per 100 metric tons (t) with an average value of $39 per carat for the Satellite Pipe and 37 Mt of ore at a grade of 16 carats per 100 t with an average value of nearly $64 per carat for the Main Pipe (Messina Diamond Corp., 2000, p. 8). In December 1999, Messina signed an option agreement with the Industrial Development Corporation (IDC) of South Africa whereby IDC could obtain up to a 40 % interest in the new operating company Liqhobong Mining Development Company (Pty.) Ltd. with a maximum investment of $3 million, subject to IDC's completion of a successful feasibility study on the Satellite Pipe. Completed in September 2000, the final feasibility study estimated mine reserves amenable to open pit mining at the Satellite Pipe to be more than 1.9 Mt at a grade of 60 carats per 100 t. The study estimated that $7.1 million would be required to bring the mine into production at a rate of 420,000 metric tons per year of ore and at a full capacity output of 300,000 carats per year during a 5-year mine life. A production development decision was expected in early 2001 (MineGem Inc., 2000).

Letseng Diamonds (Pty.) Ltd. and its partner New Mining Corporation of South Africa (88%), which was a black empowerment group spun off during the unbundling of JCI Ltd., and the Government (12%) announced plans to reopen mining of the kimberlite pipes at Lets'eng-la-Terae. The Government can acquire an additional 12% equity interest through reinvestment of future dividends. De Beers Consolidated Mines Ltd. had recovered 289,000 carats from the mine between 1977 and 1982. A capital investment of around $17 million would be required to reopen a satellite open pit and to reprocess 5 Mt of low-grade stockpiled ore left by De Beers. Remaining resources included 12 Mt down to 140 meters (m) depth at the satellite pit and 50 Mt of ore down to 300 m in the old main pipe. The mine was expected to produce more than 50,000 carats per year during its 20-year life. Although the average resource grade was only 3 carats per 100 t, the frequency of large, higher value stones above 10 carats was 10 times higher than other kimberlites. About 15% of the diamonds to be mined were expected to be larger than 10 carats and 1.5% larger than 100 carats (Tassel, 2000). DiamondWorks Ltd. of Canada held a mining lease over part of the Kao kimberlite pipe; during 2000, however, the company was primarily focused on its diamond holdings in Angola.

The revival of the diamond mining industry in Lesotho showed some hope for new opportunities for Basotho mineworkers displaced from the South African gold mines and for replacing related lost Government revenues.

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Major Sources of Information

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THE MINERAL INDUSTRY OF

LIBYA

By Philip M. Mobbs

About 98% of Libya's foreign exchange revenues were attributed to the hydrocarbon sector, so rising oil prices through 1999 and 2000, coupled with the suspension of United Nations economic sanctions, considerably brightened the country's financial position. Oil revenues were estimated to be $12 billion in 2000 compared with $7 billion in 1999 and $5.5 billion in 1998. Reliable basic economic data were not readily available to make generalizations about the size of Libya's economy (Critchlow, 2001, p. 22; World Bank Group, September 13, 2000, Libya—At a glance, accessed October 24, 2000, at URL http://www.worldbank.org/cgi-bin/sendoff.cgi?page=%2Fdata%2Fcountrydata%2Faag%2Flby_aag.pdf).

Libya was the second largest crude oil producer in Africa after Nigeria. At 29.5 billion barrels, Libya's petroleum reserves were the largest on the African Continent (U.S. Energy Information Administration, July 2001, Libya—Energy overview, Country Analysis Brief, accessed September 14, 2001, at URL http://www.eia.doe.gov/emeu/cabs/libya.pdf).

Government Policies and Programs

Laws that regulated foreign investment in Libya's mineral industry included law 5—the Encouragement of Foreign Capital Investment Law of 1426 (1997), and law 25, the Petroleum Law of 1955. During 2000, the 1999 draft of the proposed Petroleum Investment Law continued to work its way through the Government. The Ministry of Petroleum was abolished and its policy functions absorbed by the National Oil Corp.

In 1999, the United Nations suspended the sanctions that had been imposed on Libya under United Nations Security Council Resolutions 748 of 1992 and 883 of 1993. The United States retained its embargo of Libya, which was first imposed in 1986, under the Libyan Sanctions Regulations (Title 31 Part 550 of the U.S. Code of Federal Regulations) and extended by the Iran and Libya Sanctions Act of 1996 (Public Law 104-172).

The Libyan Government increasingly encouraged foreign investment in petroleum production and processing. In 1999 and 2000, foreign investment in the oil sector increased as the perceived threat of U.S. sanctions appeared to diminish. In May 2000, the Government opened an additional 137 petroleum exploration blocks to foreign investment. The Libyan Government anticipated that European and U.S. oil companies would lobby the U.S. Government to lift its sanctions (Khalaf, 2000).

Commodity Review

With the exception of the subsidized state-owned Libyan Iron and Steel Co. (LISCO), which primarily was supplied by imported raw materials, the nation's nonfuel mineral industry sector made a negligible impact on the economy. The nonfuel mineral sector included the production of ammonia and urea at the Marsa El Brega ammonia plant; the manufacture of cement by the Arabian Cement Co. and the Libyan Cement Co.; the quarrying of clay, gypsum, and limestone near Al Khums, about 90 kilometers (km) northwest of Misurata; the quarrying of limestone and dolomite and production of lime and calcined dolomite for LISCO at As Seddadah, about 125 km southwest of Misurata; and the extraction of salt from the coastal plains near Benghazi and Tripoli.

Iron and Steel.—The Wadi ash Shatti iron ore deposit near Brach, about 65 km north of Sabha and about 650 km south of Misurata, was estimated to contain about 1.6 billion metric tons of (in order of abundance, oolitic hematite, limonite, chamosite, and siderite with a grade range of 30% to 48% iron, Goudarzi, 1970, p. 2, 57, 63-69). Development of the Wadi ash Shatti iron ore resources was contingent on economic ore beneficiation and transportation programs.

The LISCO iron and steel plant at Misurata included two 550,000-metric-ton-per-year (t/yr) Midrex direct-reduction (DR) modules to produce sponge iron (LISCO I), a 650,000-t/yr Midrex DR module to produce hot-briquetted iron (LISCO II), six electric-arc furnaces with a combined capacity of 1.25 million metric tons per year of liquid steel, an 800,000-t/yr bar and rod mill, a 580,400-t/yr hot strip mill, a 140,000-t/yr cold-rolling mill, a 120,000-t/yr light and medium section mill, and an 80,000-t/yr galvanizing line (Libyan Iron and Steel Co., April 14, 2001, Plants, accessed September 13, 2001, at URL http://www.libyansteel.com/plants.htm). Hot-briquetted iron had become a significant Libyan mineral export since the LISCO II plant began production in 1997. About 54% of LISCO's exports (by weight) in 2000 was hot-briquetted iron. Bars and rods shipped to Egypt and Tunisia accounted for about 23% of the company's exports.

Hydrocarbons.—Oil and gas exploration activity was expected to increase rapidly as international oil companies flocked to Libya. Given the extensive underexplored areas in the country, the potential exists for a number of significant discoveries (Rusk, 2000). In 2000, the Repsol YPF Group of Spain (32%), the TotalElfFina Group of France (24%), OMV Exploration & Production Ltd. (24%), and Saga Petroleum Mabruk (20%) announced the A-1 exploration well on block NC-186 was a hydrocarbon discovery. Sirte Oil Co. reportedly made a 13-billion-cubic-meter-per-year natural gas discovery in the Sirte Basin (Africa Energy Intelligence, 2000a, b).

In 1999, Agip North Africa B.V. and National Oil Corp. of Libya agreed to pursue the development of two natural gas fields in western Libya—the C structure on offshore block NC-41, which is about 110 km north of Tripoli in 180 meters of water, and the Wafa prospect on block NC-169, which is about 550 km southwest of Tripoli. Condensate and gas pipelines from the two fields will be laid to transport gas and liquids to the Melitah gas plant, which was under construction between Sabratha and Zuara, and is about 80 km west of Tripoli. The

Green Stream export gas pipeline was to be built to Gela, Sicily, through which the partners proposed to export to Sicily about 8 billion cubic meters per year of natural gas and dedicate about 2 billion cubic meters per year to the domestic Libyan market (Eni S.p.A., 1999; Eni S.p.A., [undated], Libya, accessed September 17, 2001, at URL http://www.eni.it/english/mondo/africa/libia.html). A 2.8-billion-cubic-meter-per-year gas plant was under construction as part of Sirte Oil's expansion of the Attahady gas facilities (Stell, 2000).

In 2000, Red Sea Oil Corp.'s En Naga North and West oil prospect on block NC-177 was declared by the Government to be commercial and, therefore, eligible for development. Lundin Oil AB subsequently acquired Red Sea Oil.

The renovation of the 120,000-barrel-per-day Azzawiya refinery continued. A reformer was being installed to improve the quality and to increase the volume of produced gasoline and diesel fuel (Oil & Gas Journal, 2000).

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TABLE 1
LIBYA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998 e/	1999 e/	2000 e/
Cement, hydraulic		3,550	2,524	3,000	3,000	3,000
Gas, natural:						
Gross	million cubic meters	12,640	12,910	12,600	12,400	12,000
Dry	do.	6,420	6,570	6,360	6,200	6,100
Gypsum e/		175	125	150	150	175
Iron and steel:						
Metal:						
Direct-reduced iron 4/		862	990	1,010 5/	1,330 5/	1,500 5/
Crude steel		863	897	925 5/	945 5/	1,055 5/
Lime e/		260	275	275	270	270
Nitrogen:						
N content of ammonia		545	536	545 r/	552 r/	552 5/
N content of urea		399	383	408 r/	386 r/	407 5/
Petroleum:						
Crude	thousand 42-gallon barrels	529,000 r/ e/	544,000 r/ e/	540,000 r/	520,000 r/	538,000
Refinery products:						
Gasoline	do.	16,000	16,200 e/	16,800 r/	10,000	12,000
Kerosene and jet fuel	do.	14,200	14,300 e/	12,700 r/	7,000	8,400
Distillate fuel oil	do.	31,400	31,500 e/	31,800 r/	20,000	24,000
Residual fuel oil	do.	35,400	35,500 e/	33,600 r/	25,000	30,000
Other	do.	18,000	18,000 e/	20,000 r/	13,000	15,600
Total	do.	115,000	116,000 e/	115,000 r/	75,000	90,000
Salt e/		30	30	30	30	40
Sulfur, byproduct of petroleum and natural gas e/		13	13	13	13	13

e/ Estimated. r/ Revised.

1/ Table includes data available through September 11, 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ In addition to the commodities listed, a variety of brick, dolomite, limestone, methanol, crushed construction stone, and tile was produced, and natron (soda ash) may have been produced, but available information is inadequate to make estimates of output levels. Natural gas liquids were also produced but were blended with crude petroleum and reported as part of that total.

4/ Includes hot briquetted iron.

5/ Reported figure.

THE MINERAL INDUSTRY OF

MADAGASCAR

By Thomas R. Yager

The Republic of Madagascar, which is the world's fourth largest island, is about 420 kilometers (km) east of Mozambique in the Indian Ocean. Its mining industry has been chiefly noted for the production and export of chemical- and metallurgical-grade chromite ore, high-quality crystalline flake graphite, and mica. In addition to these minerals, small quantities of beryllium, gold, and rare earths have been produced, as well as industrial mineral commodities, including cement, feldspar, precious and semiprecious gemstones, quartz, salt, and ornamental stones. Madagascar was also known to have deposits of bauxite, coal, copper, lead, manganese, nickel, platinum, tin, titanium, zinc, and zirconium.

In 1999, Madagascar's gross domestic product (GDP) amounted to about $11.5 billion at purchasing power parity, which was an increase of 4.5% compared with that of 1998. Per capita income was $780 in 1999. Industry accounted for about 12% of GDP (U.S. Central Intelligence Agency, 2000). Madagsacar's economy was negatively affected by rising oil prices and falling export prices.

On May 11, 2000, the Bureau du Cadastre Minier de Madagascar (BCCM) (Mining Deeds Office) was established following an overhaul of Madagascar's mining regulations. The BCCM will serve as a one-stop service for mining operators. The new regulations strictly define licenses and mining concessions and establish a new system of licenses based on a standard surface unit of 6.25 square kilometers (km^2). The "R" permit gives its owner exclusive rights to conduct studies and exploration within a limited area. An "E" license gives exclusive rights for exploration and mining within a limited area. The "PRE" license, which is reserved for small-scale miners, gives prospecting and mining rights within a concession. Companies that invest more than $350,000 are offered such incentives as access to foreign currency, the right to transfer money abroad to purchase mining equipment, and tax breaks that allow for a faster return on investment and recovery of money spent in the study and exploration phases (Africa Energy & Mining, 2000b).

Commodity Review

Metals

Aluminum.—Most of Madagascar's bauxite resources occur in the southeastern part of the country. The Manantenina deposit has resources of 165 million metric tons (Mt) at a grade of 41% Al_2O_3; this deposit was believed to contain the country's most promising bauxite resources. Resources at the Farafangana deposit were estimated to be 100 Mt a grade of 37% Al_2O_3. The Ankaizina deposit was estimated to have resources of 55 Mt at a grade of 40.7% Al_2O_3. Lower grade deposits were found northwest of Antananarivo with total resources of 10 to 15 Mt (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm).

Beryllium.—In 1998, Madagascar produced about 30 metric tons (t) of beryl in quartz concentrates (table 1). The country's largest beryl deposits are found in pegamites at Ambatofinadrahana, Ampandramaika Malakialina, and Tsaratanana. Other deposits include Betafo Antsirabe, Miandrivazo, and Itrongay (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm).

Copper.—Modest deposits of copper occur at Ambatovarahina, Besakoa, and Daraina. Ambatovarahina has resources of 252,000 t at a grade of 4.75% copper. Besakoa has resources of 1 Mt at a grade of 0.6% copper. Exploitation of the resources at Ambatovarahina by a small mining operation was under consideration, and the resources at Besakoa were considered to be uneconomic (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm).

Gold.—Numerous deposits of gold, which include Ampanihy in the south, Andavakoera in the northeast, Farafangana on the east coast, Maevatanana in the northwest, and Miandrivazo in the west, occur in Madagascar. Although most gold production was artisanal and not officially reported, the country's actual production has been estimated to be about 2 metric tons per year (t/yr) (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Gold, precious stones, semiprecious stones, and ornamental stones, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_21.htm).

Iron.—Resources in the iron ore deposits near Soalala have been estimated to be 360 Mt at a grade of 35% iron. The Betioky deposit has 30 Mt of ore that grades 24% iron and 130 Mt of ore that grades 10% to 14% iron. The Bekisopa deposit had 10 Mt of ore at a grade of 60% iron and 130 Mt at a grade of 10% to 14% iron. Resources at Fasintsara were estimated to be 30 Mt of ore at grade of 36% iron and 75 Mt at a grade of 34% iron. The Fenoarivo deposit has estimated resources of 100 Mt at a grade of 30% to 40% iron. Resources at Ambatovy were estimated to be 30 Mt at a grade of 46% to 47% iron. The Ambohimahavonjy deposit has estimated resources of 15 Mt at a grade of 30% to 40% iron. Small deposits also occur at Alaotra, Maevatanana, and Mantasoa. The Soalala deposits were considered to be the most economical; the Ambatovy and the Ambohimahavonjy deposits were also considered to be exploitable (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm).

Manganese.—Deposits of manganese occur in the area of Ampanihy and Bekily and at Antanjona, Lac Alaotra, Mahamvo, and Masakoamena. The small size of these deposits would probably restrict their use to small local industries, such as ceramics, glass, and matches (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm).

Nickel.—Substantial resources of nickel are found at the Ambatovy lateritic deposit, which is near the Antananarivo-Tomasina railroad. A drilling program by Phelps Dodge Corp. established a proven resource of 52 Mt of ferralite and saprolite material at a grade of 1.24% nickel, 0.09% cobalt, and 0.8% magnesium (cutoff of 0.8% nickel). Total resources have been estimated to be 168 Mt at a grade of 1.11% nickel and 0.1% cobalt. Phelps Dodge planned to develop Ambatovy into a 36,000-t/yr nickel and 3,000-t/yr cobalt mine. Extensive nickel laterites also occur on the east coast between Fenoarivo and Mananjary (Mining Journal, 1998; Premoli, 2000). Smaller deposits occur at Valozoro, which has resources of 3.7 Mt at a grade of 1.75% nickel, and at Bemainty, which has resources of 1.6 Mt at a grade of 1.3% nickel (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm).

Rare Earths.—Madagascar produced small amounts of bastnaesite and monazite until 1996. Deposits of bastnaesite occur at Ambatofinandrahana. The heavy-mineral sands at Tolagnaro contain 310,000 t of monazite, and other minerals sands on the southeast coast, 177,000 t of monzanite. Deposits located 100 km north of Tolagnaro have resources of about 64,000 t with a high thorium content. The Antete monazite deposit has resources of 15,000 t. Other monazite deposits occur at Mahajanga and Morombe. The Bekolosy pyrochlore deposit, which occurs in alkaline granites, has estimated resources of 10 Mt at a grade of 0.4% pyrochlore. The Berere and the Itasy deposits occur in pegamatites. Berere contains fergusonite and xenotine; Itasy, euxenite and fergusonite; and Maharidaza, euxenite. The Office des Mines Nationales et des Industries Stratégiques (OMNIS) was considering a joint venture to exploit the Madaridaza deposit (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm).

Titanium.—Madagascar is known to have substantial deposits of titanium. On the southeastern coast, deposits are found in the area of Tolagnaro. Resources in the largest deposit, which is near Tolagnaro, were estimated to be 11.6 Mt of ilmenite at a grade of 47% to 51% titanium and 678,000 t of zircon. Another deposit near Tolagnaro has estimated resources of 2 Mt ilmenite. Resources at Tomasina were estimated to be 12 Mt ilmenite at a grade of 48% titanium and 700,000 t zircon. Other deposits were found on the western coast at Morombe and Tambohorano and in the northern part of the country (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Metals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_23.htm). The Talagnaro deposits have been explored by QIT-Fer et Titane (a subsidiary of Rio Tinto plc). The cost of developing this project was estimated to be $400 million (Premoli, 2000). Development of these deposits was pending favorable market and investment conditions and environmental assessments.

Uranium.—Resources of uranium occur in the monazite sands at Tolagnaro. In April 1999, OMNIS signed an agreement with the French firm Compagnie Generale des Matieres Nucleaires to explore for uranium in the Morondova basin.

Industrial Minerals

Cement.—The International Cement Review (2001) estimated that Madagascar's consumption and production of cement grew by 5% and 10%, respectively, in 2000. In 1999, cement imports fell to 66,595 t at a value of $3.26 million from 97,145 t at a value of $5.81 million in 1998. Malaysia accounted for 72% of cement imports, and Oman, 28% (International Trade Center and United Nations Statistics Division, 2001).

Chromite.—Resources of crude chromite ore at Bemanevika amounted to 2.28 Mt; Ankazotaolana, 700,000 t; and other deposits, 900,000 t. Madagascar was the world's 10th largest producer of chromite (Premoli, 2000). Kraomita Malagasy produced concentrates (49% chromite) and lumpy ore (42% chromite) from the mine at Ankazotaolana. The company planned to reopen its mine at Bemanevika owing to resource depletion at the Ankazotaolana Mine (Indian Ocean Newsletter, 2001). Madagascar's exports of chromite products fell to 57,500 t at a value of $3.15 million in 1999 from 147,700 t at a value of $9.12 million in 1998. Japan accounted for 51% of chromite exports, and China, 49% (International Trade Center and United Nations Statistics Division, 2001).

Gemstones.—In 1999, Madagascar exported gemstones worth $15.18 million, which was a 212% increase compared with that of 1998 and a 270% increase compared with that of 1995. Exports of cut stones fell to $1.15 million in 1999 from $2.26 million in 1995, and exports of rough stones rose to $14.03 million from $1.85 million in the same period. Thailand accounted for 74% of exports; Sri Lanka, 8%; the United States, 4%; Hong Kong, 3%; France, 3%; and others, 8% (International Trade Center and United Nations Statistics Division, 2001). The International Monetary Fund (2000, p. 58) indicated that sapphire exports amounted to 2.5 t at a value of $2.7 million in 1998 and 3.8 t at a value of $12.5 million in 1999. In 2000, most of Madagascar's official sales of precious stones came from the Ilakaka sapphire mines. The country's production of precious stones is probably worth far more than the official figures; smuggling has been a serious problem (African Mining Intelligence, 2001).

From 1994 to 1998, the production of ornamental stones and semiprecious stones increased substantially. During this period, aragonite, which was consistently the dominant ornamental stone, accounted for 69% of total ornamental stone production. Labradorite accounted for 13%, and others, 18%. From 1994 to 1998, tourmaline, which was the leading semiprecious stone, accounted for 33% of production. Beryl accounted for 29%; garnet, 13%; citrene, 9%; amethyst, 7%; and others, 9% (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Gold, precious stones, semiprecious stones, and ornamental stones, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_21.htm).

Graphite.—Substantial deposits of graphite occurred in the Ambatolampy, the Ampanihy, and the Manampotsy districts. Madagascar's graphite resources have been estimated to be 960,000 t (Kalyoncu, 2001). The country's largest producer of graphite was Etablissements Gallois, which had three mines in Ambalafotaka, Antsirakambo, and Marovintsy on the eastern coast and a plant in Tomasina. Other companies that mined graphite in Madagascar included Etablissements Izouard, Etablissements Rostaing, Société Louys, and Société Minière de la Grande Ile. Exports of graphite fell to 9,244 t at a value of $4.66 million in 1999 from 13,087 t at a value of $6.7 million in 1998. In 1999, the United Kingdom accounted for 38% of exports, Germany, 36%, the United States, 20%, and others, 6%. The refractories industry was the main consumer of Malagasy graphite (International Trade Center and United Nations Statistics Division, 2001).

Mica.—Substantial resources of phlogopite and much smaller deposits of muscovite occur in Madagascar. In recent years, only phlogopite has been mined. Deposits of mica included the Ambarata, the Ampandrandava, the Benato, and the Maniry Miary. The Ampandrandava deposit was mined by SOMIDA and the Maniry Miary deposit, by Exploitation Miniere DELORME. (Fonds d'Appui au Secteur Privé, 2000, Mining sector of Madagascar—Industrial minerals, accessed July 23, 2001, at URL http://www.madagascar-contacts.com/fasp/Sec_Mines/BDSMines_B2_21.htm). Most of the country's mica production was exported; in 1999, Belgium accounted for 81% of mica exports, Japan, 14%, and others, 5% (International Trade Center and United Nations Statistics Division, 2001).

Quartz.—Deposits of citrene, industrial quartz, rose quartz, and smoky quartz occur in Madagascar. Industrial quartz was found at Kandreho, Mananara, and Maroantsetra; the Kaandreho deposit was mined by Rollmine, and the Mananara and the Maroantsetra deposits were mined by Prexmin. Citrene occurred at Mananara and Maroantsetra; rose quartz, at Ampandramaika, Andrianampy, and Samiresy; and smoky quartz, near Antongil Bay. In 1999, Madagascar exported 586 t of quartz and quartzite; Hong Kong accounted for 49%; and Russia and Germany, 15% each (International Trade Center and United Nations Statistics Division, 2001).

Mineral Fuels

Coal.—Madagascar is known to have substantial deposits of coal. The resources at Sakoa in the southwestern part of the country have been estimated by BHP Ltd. and several other companies to exceed 100 Mt (Premoli, 2000). Madagascar's coal resources have not yet been exploited; the country imported 7,686 t of coal in 1998 and 3,030 t in 1999 from the Republic of South Africa (International Trade Center and United Nations Statistics Division, 2001).

Petroleum.—Because Madagascar did not produce crude petroleum, it relied on imports for its refinery. In 1999, imports of crude petroleum increased to about 2.86 million barrels (Mbbl) at a value of $69.63 million from about 2.75 Mbbl at a value of $51.06 million in 1998. About 85% of Madagascar's crude petroleum was imported from Iran, and from Qatar, about 15%. The value of refined petroleum products amounted to $50.2 million in 1998 and $50.6 million in 1999 (International Trade Center and United Nations Statistics Division, 2001).

The country's petroleum refinery had a capacity of 15,000 barrels per day and was operated by Solitany Malagasy (SOLIMA), which was the state-owned petroleum products company. At the end of 2000, the Government had not finished the privatization of SOLIMA. Galana Petroleum Ltd., which was the company chosen as buyer, had serious concerns about the refinery's environmental problems and wanted SOLIMA to clean up the site (Africa Energy & Mining, 2000a). The World Bank, which has been urging the Government to sell SOLIMA, felt that enough progress toward privatization had been made to disburse the first portion of a structural adjustment loan (Africa Energy & Mining, 2000c).

The American firm Xpronet Resources Inc. and OMNIS signed two exploration and production-sharing agreements. Xpronet will work two offshore blocks in the Mozambique channel off Madagascar's western coast; the Rivomena block was 77,500 km^2, and the Mavony block, 64,500 km^2. The licenses will be wholly owned by Xpronet, and the cost of the seismic surveys and drilling could amount to between $35 million and $50 million (Africa Energy Intelligence, 2000).

Infrastructure

The International Monetary Fund (2000, p. 55) estimated that Madagascar produced 659 gigawatthours of electricity in 1999, which was an increase of 2.6% compared with that of 1998 and 19.4% compared with that of 1995. Hydroelectric power sources provided 72.1% of the country's electricity, and fossil fuel sources accounted for the remaining 27.9%. The electric power industry was dominated by Jiro Sy Rano Malagasy, which was Madagascar's state-owned electric utility. Madagascar's known exploitable potential hydroelectric energy is 23,061 megawatts (World Resources Institute and others, 1996, p. 288).

Madagascar had about 50,000 km of roads, of which approximately 5,800 km was paved. The rail network covered nearly 900 km (U.S. Central Intelligence Agency, 2000). The country's infrastructure is in need of major repairs and expansion; its inadequacy has been a key factor in reducing the output of SOLIMA's refinery and preventing the development of Madagascar's bauxite, coal, and iron ore deposits (Crankshaw, 2001).

Madagascar's mineral industry has considerable potential, but its success ultimately depends upon the country's ability to reform the economy and to deal with chronic malnutrition, environmental issues such as deforestation and erosion, population growth, and underfunded health and education facilities. Positive developments in 2000 included the new mining regulations and the decision of the International Monetary Fund and the World Bank to grant Madagascar $1.5 billion in debt relief.

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TABLE 1
MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Kilograms unless otherwise specified)

Commodity 3/		1996	1997	1998	1999 e/	2000 e/
METALS						
Beryllium, beryl in quartz concentrates, industrial and ornamental		11,160 r/	28,287 r/	30,000 r/	20,600 r/	21,500
Chromium:						
Run of mine e/		146,300 4/	143,800 4/	107,400	-- 4/	122,000
Marketable output:						
Chromite concentrate, gross weight	metric tons	51,500 r/	45,000 r/	19,000 r/	-- r/ 4/	21,600
Chromite ore, lumpy	do.	85,710 r/	94,700 r/	85,300 r/	-- r/ 4/	97,200
Total	do.	137,210	139,700	104,300 r/	-- r/ 4/	118,800
Gold, mine output, Au content 5/		7 r/	8 r/	12 r/	8 r/	9
INDUSTRIAL MINERALS						
Abrasives, natural (industrial only) e/		7,700 r/	1,314 r/	1,280 r/	875 r/	915
Cement, hydraulic	metric tons	44,332 r/	36,217 r/	44,327 r/	45,719 r/ 4/	48,000
Clay, kaolin e/	do.	34 r/	166 r/	160 r/	110 r/	115
Feldspar e/		5,348 r/	-- r/	5,660 r/	3,880 r/	4,050
Gemstones: 6/						
Ornamental stones:		1,093,356	1,072,875	2,395,715	2,400,000	2,400,000
Semiprecious stones:		966	1,835	1,225	1,200	1,200
Graphite, all grades, shipments	metric tons	11,295	15,397 r/	18,690 r/	14,500 r/	15,200
Mica, phlogopite:						
Block e/	do.	1	4 r/	4 r/	3 r/	3
Scrap e/	do.	285 r/	1,020 r/	1,010 r/	690 r/	715
Splittings and sheet e/	do.	31 r/	114 r/	105 r/	72 r/	82
Total	do.	317 r/	1,138 r/	1,119 r/	765 r/	800
Quartz, industrial: e/						
Crystal		29,900 r/	32,400 r/	31,700 r/	21,700 r/	22,700
Piezoelectric		61,600 r/	66,900 r/	65,300 r/	44,700 r/	46,700
Smelting		168,000 r/	182,000 r/	178,000 r/	122,000 r/	127,000
Salt, marine	metric tons	41,750 r/	36,800 r/	35,900 r/	44,409 r/ 4/	46,400
Stone:						
Dimension stone	do.	479 r/	2,740 r/	1,878 r/	1,290 r/	1,340
Marble, cipoline e/		1	1	1	1	1
MINERAL FUELS AND RELATED MATERIALS						
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	444 r/	607 r/	583 r/	617 r/ 4/	640
Kerosene and jet fuel	do.	342 r/	454 r/	474 r/	409 r/ 4/	430
Distillate fuel oil	do.	589 r/	788 r/	697 r/	749 r/ 4/	780
Residual fuel oil	do.	1,003 r/	1,331 r/	1,370 r/	1,251 r/ 4/	1,300
Other	do.	35 r/	59 r/	49 r/	61 r/ 4/	60
Total	do.	2,413 r/	3,239 r/	3,173 r/	3,087 r/	3,210

e/ Estimated. r/ Revised. -- Zero.

1/ Estimated data are rounded to no more than three significant digits.

2/ Includes data available through July 2001.

3/ In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (other clays, sand and gravel, and stone) and industrial calcite presumably were produced, but output was not reported quantitatively, and available information was inadequate to make reliable estimates of output levels.

4/ Reported figure.

5/ Does not include smuggled artisanal production, which was estimated to be 2,000 kilograms per year.

6/ Does not include smuggled artisanal production.

THE MINERAL INDUSTRIES OF

MOROCCO AND WESTERN SAHARA

By Philip A. Szczesniak

Morocco's oil and gas industry announced in 2000 a "major" discovery in northeastern Morocco, but then the original estimates were lowered after further analysis. The prospects for other finds, however, drew international interest. Government officials noted that despite the oil discovery, in the near future the economy would continue to be highly dependent on imported oil which continued to negatively affect the economy. In 1999, Morocco's gross domestic product based on purchasing power parity was estimated at $108 billion and exports were $7.4 billion led by agricultural products; the leading mineral export was phosphate rock at $434 million. As of July 2000, the estimated population for Morocco and Western Sahara was more than 30 million (U.S. Central Intelligence Agency, 2000, Morocco—Economy, World Factbook 2000, accessed August 16, 2001, at URL http://www.odci/gov/cia/publications/factbook/geos/mo.html; U.S. Central Intelligence Agency, 2000, Western Sahara—Economy, World Factbook 2000, accessed August 16, 2001, at URL http://www.odci/gov/cia/publications/factbook/geos/wi; World Bank, August 28, 2000, Morocco at a glance, accessed September 18, 2001, via URL http://www.worldbank.org/data/countrydata/countrydata.html). Morocco and Western Sahara were the world's third largest producer of phosphate rock after the United States and China in 2000 (Jasinski, 2001). Morocco also mined a wide range of minerals that included antimony, barite, coal, cobalt, copper, fluorspar, gold, iron ore, lead, manganese, salt, silver, and zinc and had a significant capacity for conversion of phosphate rock into fertilizer. The mineral industry was Morocco's largest foreign-exchange-earning sector.

The Government agency responsible for overseeing the mining industry of Morocco is the Ministry of Industry, Trade, Energy, and Mines. Several state-owned organizations play a direct role in mineral resource development. The Bureau de Recherches et de Participations Minières (BRPM) is responsible for the development of most mineral resources. La Centrale d'Achat et de Development de la Region Minière de Tafilalet et de Figuig was formed to promote and support the interests of artisanal miners in the Tafilalet and Figuig regions. The Office Cherifien des Phosphates (OCP) is responsible for managing and controlling all aspects of phosphate mining and beneficiation (Mbendi, April 24, 2001, Morocco—Mining—Overview, accessed September, 19, 2001, at URL http://www.mbendi.co.za/indy/ming/af/mo/p0005.htm).

The Office National de Recherches et d'Exploitations Petrolieres (ONAREP) is responsible for overseeing the energy sector (Mbendi, July 12, 2001, Morocco—Oil and gas industry, accessed September, 25, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/mo/p0005.htm). During 2000, ONAREP made changes to petroleum laws to encourage more investment. More specifically, new petroleum laws included a 10-year tax holiday after first production for offshore operators and a reduction in royalty payments to 10% for onshore and shallow water producers and to 7% for deepwater producers (World Oil, 2000).

Holding Minier du Groupe ONA (Managem) of Morocco announced that it would develop the gold deposit at Akka. In September 2000, Managem signed an agreement with La Société de promotion et de participation pour la coopération économique (Proparco) (a subsidiary of Agence Francaise de Developpement) for a $20 million loan that will help fund the project (Africa Energy & Mining, 2000a). Managem and BRPM estimated that the deposit's reserves were 30 metric tons (t) of gold (Middle East Economic Digest, 1999).

In July, Icelandic Gold Corp. announced that owing to unsuccessful attempts at funding, it was relinquishing its option on the Zkounder silver project, which is located 770 kilometers (km) south of Rabat (Yahoo!News, July 11, 2000, Icelandic Gold withdraws from Zkounder, accessed July 12, 2000, at URL http://biz.yahoo.com/em/000711/j.html). In September 2000, BRPM launched a preselection tender for the Zkounder silver deposit. The deposit covers an area of 5 km and has estimated resources of 300,000 t that grades between 300 and 800 grams per metric ton silver concentrate (Actualités Presse, September 25, 2000, Morocco launches tender for Zkounder silver mine, accessed May 15, 2001, at URL http://www.aim.net.ma/Sept258.htm).

In September 2000, the Société Nationale de Sidérurgie launched the construction of a new industrial plant that is expected to produce concrete steel-reinforcement bars and hot-rolled metal sections. The 300,000-metric-ton-per-year-(t/yr)-capacity rolling mill, which covers an area of 25 hectares inside the Jorf Lasfar industrial area, was expected to start production in 2002 at a cost of $60 million (Metal Bulletin, 2000; Mincom Iiaycom weekly news, September 2000, King Mohammed VI launches construction materials unit plant, accessed September 24, 2001, at URL http://www.mincom.gov.ma/news/2000/2509to3009/roy/roy.htm).

In the cement sector, the leading companies that operated in Morocco in 2000 were Lafarge Ciments of France, Ciments du Maroc (controlled by Italcementi of Italy), Ciments de l'Oriental (CIOR) (controlled by Holderbank of Switzerland), and Asmet de Temara (controlled by Cimentos de Portugal SGPS, SA). In 2000, Managem and Lafarge Ciments announced a joint venture to build a 960,000-t/yr-capacity cement plant in the northern Moroccan city of Tetuan. The plant would cost $120 million and was anticipated to begin operating by 2003. They also noted that the plant would help meet Moroccan cement needs, which they estimated would grow from 7 million to 15 million metric tons by 2015 (Arabicnews.com, January 15, 2000, Moroccan and French firms to invest $120 million in cement plant, accessed

September 25, 2001, at URL http://www.arabicnews.com/ansub/Daily/Day/000115/2000011526.html).

In late 1999, CIOR announced that it had completed feasibility studies and decided to build a 1-million-metric-ton-per-year-capacity cement plant in the Settat area, which is 140 km south of Rabat. CIOR noted that the plant, Atlacim, would require an investment of $102 million and would begin operating in 2001 (Arabic News.com, August 26, 1999, Cement firm Cior to build $102 million cement plant, accessed September 25, 2001, at URL http://www.arabicnews.com/ansub/Daily/Day/990826/1999082652.html).

In December 2000, OCP officials commented on the impact of oil and gas discoveries on the phosphate mining industry. They noted that they were very interested in the developments because the sulfur and ammonia needed for phosphate fertilizer were processed from gas. If gas reserves prove to be significant, then plans would be made to construct plants to manufacture sulfur and ammonia (Arabic News.com, December 5, 2000, OCP interested by hydrocarbon finds in Morocco, general manager says, accessed September 25, 2001, at URL http://www.arabicnews.com/ansub/Daily/Day/001205/2000120529.html). Production of phosphate rock declined slightly to 21,459,000 t in 2000 from 22,163,000 t in 1999.

In August 2000, Lone Star Energy Corp. (a subsidiary of Skidmore Energy Inc. of the United States) announced that it had discovered oil and gas in Talsinnt, a northeastern region in the High Atlas Mountains of Morocco 200 km from the Algerian border. Early estimates put reserves at more than 10 billion barrels of oil and 200 billion cubic meters of gas; those estimates, however, were later revised downward to more conservative estimates of 50 million to 100 million barrels. Lone Star Energy Corp. was expected to drill an additional 100 wells in Talsinnt, which would increase its initial investment of $30 million to $150 million; the field was expected to come on-stream within 3 years. Government officials estimated that the overall investment in developing the Talsinnt region would likely increase from $160 million to more than $1 billion (Africa Energy & Mining, 2000b; Financial Times, 2000; Middle East Economic Digest, 2000).

In 2000, petroleum exploration or prospecting licenses in force were held by the state-owned ONAREP or by joint ventures of ONAREP and international companies, which included Conoco (U.K.) Ltd., Energy Africa Ltd. of South Africa, Enterprise Oil Exploration Ltd. of the United Kingdom, Kappa Energy Co. Ltd. of Canada (formerly Cabre Exploration Ltd.), Kerr-McGee Corp. of the United States, Lasmo Overseas Nederland (II) B.V., Shell Prospecting Africa B.V., Skidmore Energy Inc. of the United States, Taurus Petroleum AB of Sweden, and Vanco Energy Co. of the United States (Arab Petroleum Research Center, 2001, p. 283).

Besides the Talsinnt region, exploration was ongoing in seven other regions—the Loukos South Offshore block in the Atlantic Ocean north of Rabat; the Al Hoceima-Nador Offshore area in the Mediterranean; the Cap Draa Haute Mer Offshore area south of Agadir; an offshore block south of Rabat; a block at Labrouj in the center of the country; an area around Ounoura, on the Atlantic coast near Essaouira; and five deepwater blocks on the Atlantic coast south of Agadir (U.S. Energy Information Administration, January 2001, Morocco—Oil and gas, accessed September 26, 2001, at URL http://www.eia.doe.gov/emeu/cabs/morocco.html).

Morocco's major oil distributor is the Société Anonyme Marocaine de l'Industriele Raffinage (SAMIR). In 2000, SAMIR was engaged in an investment project of $400 million to upgrade its refining capabilities. When the upgrade is complete, SAMIR will have a capacity of 140,000 barrels per day (Washington Times, November 27, 2000, Oil served on a silver platter, accessed March 27, 2001, at URL http://www.internationalspecialreports.com/africa/00/morocco/12.html).

In February 2001, CMS Energy Corp. of the United States announced that commercial operation had been achieved at Unit 4 of its $1.5 billion 1,356-megawatt Jorf Lasfar powerplant, which is located on the Atlantic coast of Morocco 126 km southwest of Casablanca. The Jorf Lasfar facility will generate more than one-half of Morocco's total electricity supply using coal and is considered to be the largest independent powerplant in Africa. CMS Energy has been supplying power to the Office Nationale de l'Electricité (the Moroccan national utility) (CMS Energy Corp., February 9, 2001, CMS Energy announces commercial operation of Unit 4 at Jorf Lasfar powerplant in Morocco, accessed September 26, 2001, at URL http://www.consumersenergy.com/apps/NewsArticleCMS.asp?ID=817).

In January 2001, the Office National des Chemins de Fer du Maroc announced plans to spend $162 million in 2001 on upgrading the country's railway network. Specifically, an extra track will be laid between Meknes and Fez, and port stations at Ain Sbaa and Casablanca will be refurbished. The project, which was launched in 2000, is part of a 4-year $650 million plan primarily to deal with handling increased ridership by tourists and the needs of the phosphate industry. The project was being financed by the European Investment Bank and the Japanese Bank for International Cooperation (Actualités Presse, January 26, 2001, Morocco plans to spend $162 mln in 2001 on upgrading railway, accessed May 15, 2001, at URL http://www.aim.net.ma/Jan26201.htm).

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TABLE 1
MOROCCO AND WESTERN SAHARA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000
METALS						
Antimony concentrate:						
Gross weight		345	350 e/	350 e/	350 r/	350 e/
Sb content		152 e/	160	160 e/	150 r/	150 e/
Cobalt concentrate:						
Gross weight		5,033	7,137	2,874	9,488	14,341
Co content		565	714	287	863	1,305
Cobalt recovered from tailings		80	220 e/	242	472	1,200
Copper:						
Concentrates, gross weight		37,623	37,344	26,780	25,260	23,150
Matte, gross weight		1,671	2,682	2,841	2,212	2,117
Cu content, concentrates and matte		14,550	15,400	8,200	7,747 r/	7,125
Gold e/	kilograms	482 4/	450	450	-- r/	334
Iron and steel:						
Iron ore:						
Gross weight		11,842	11,965	9,285	6,625	5,612
Fe content		8,257	8,260 e/	6,220	4,440 e/	3,760 e/
Metal: e/						
Pig iron		15,000	15,000	15,000	15,000	15,000
Steel, crude		5,000	5,000	5,000	5,000	5,000
Lead:						
Concentrate:						
Gross weight		107,577	110,507	115,042	114,184	117,510
Pb content		71,667	77,056	79,300	79,900 r/	82,300
Cupreous matte, Pb content e/		500	500	600	600	600
Metal:						
Smelter, primary only		61,749	66,202	65,000 e/	65,209 r/	66,812
Refined:						
Primary		62,700 e/	64,202	60,929	65,209	66,812
Secondary e/		3,100 4/	3,000	3,000	3,000	3,000
Total		65,800	67,202	63,929	68,200	69,812
Manganese ore, largely chemical-grade		29,466	30,806	28,332	29,150	25,830
Mercury e/		--	5	10	10	10
Silver:						
Ag content of concentrates and matte	kilograms	19,304	35,000	66,531	51,197	43,000
Ag content of mine and smelter bullion	do.	180,291	226,000	240,412	226,692	246,000
Total	do.	199,595	261,000	306,943	277,889	289,000
Zinc concentrate:						
Gross weight		152,580	171,796	216,011	216,197	201,741
Zn content		79,662	89,248	112,000	111,703	105,107
INDUSTRIAL MINERALS						
Barite		282,537	338,096	353,438	328,945	320,243
Cement, hydraulic	thousand tons	6,585	7,236	7,200 e/	7,200 e/	7,200 e/
Clays, crude:						
Bentonite		39,680	49,633	33,311	36,528	21,352
Fuller's earth (smectite)		17,223	24,425	27,650	21,956	30,665
Montmorillonite (ghassoul)		3,169	2,933	3,180	2,750	2,476

See footnotes at end of table.

TABLE 1--Continued
MOROCCO AND WESTERN SAHARA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000
INDUSTRIAL MINERALS--Continued						
Feldspar		12,659	15,110	18,332	1,112	8,400
Fertilizers	thousand tons	2,200 e/	2,200 e/	2,132	2,111	2,100 e/
Fluorspar, acid-grade		95,900	103,800	105,000	83,100	77,800
Gypsum e/		450,000	450,000	450,000	450,000	450,000
Mica e/		600	600	600	210 4/	1,897 4/
Phosphate rock (includes Western Sahara):						
Gross weight	thousand tons	20,855	23,084	23,587	22,163 r/	21,459
P_2O_5 content	do.	6,552	7,848	7,850	7,500	7,200
Phosphoric acid	do.	2,583	2,600 e/	2,669	2,696	2,731
Salt:						
Rock		138,290	210,000 e/	107,604	156,158 r/	147,960
Marine e/		32,530 4/	47,500	40,000	40,000	40,000
Talc and pyrophyllite		13,053	19,850	12,000 r/ e/	12,522 r/	14,655
MINERAL FUELS AND RELATED MATERIALS						
Coal, anthracite		505,600	376,300	269,100	129,200	28,725
Gas, natural:						
Gross	million cubic meters	22	38	43	44	44 e/
Dry e/	do.	20 4/	35	38	39	39
Petroleum:						
Crude	thousand 42-gallon barrels	35	35	35	35	35 e/
Refinery products: 5/						
Liquefied petroleum gas	do.	2,000	2,489	2,617	3,129	2,800
Gasoline	do.	3,000	3,428	3,548	3,842	3,833
Jet fuel	do.	2,000	1,982	2,544	2,213	2,230
Kerosene	do.	300	481	611	750	802
Distillate fuel oil	do.	14,000	17,800	16,667	18,716	18,000 e/
Residual fuel oil	do.	10,000	11,394	12,766	16,706	16,000 e/
Other	do.	5,000	6,000	8,517	5,296	5,000 e/
Total	do.	36,300	43,574	47,270	50,652	48,665 e/

e/ Estimated. r/ Revised. -- Zero.

1/ Includes data available through September 26, 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ In addition to the commodities listed, arsenic trioxide and a variety of crude construction materials are produced; but information is inadequate to make estimates of output levels.

4/ Reported figure.

5/ Refinery fuel and losses have been included in the output of individual products and is estimated to be about 1.8 million barrels per year.

TABLE 2
MOROCCO AND WESTERN SAHARA: STRUCTURE OF THE MINERAL INDUSTRY IN 2000

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Anthracite coal	Charbonnages du Maroc [Bureau de Recherches et de Participations Minières (BRPM), 98.89%]	Jerada	650,000.
Barite	Compagnie Marocaine des Barytes (COMABAR) (BRPM, 22.5%; Norbar Minerals AS, 55%)	Zelmou	150,000.
Do.	do.	Safi	80,000.
Do.	Société Nord Africaine de Recherches et d'Exploitation des Mines d'Argana	Argana	30,000 chemical grade.
Do.	do.	do.	120,000.
Bentonite	Tolsa, SpA (Tolsa, 100%)	Iboughardain	20,000.
Do.	Société d'Exploitation des Mines du Rif (BRPM, 100%)	Ouizane- Bouhoua	15,000.
Do.	Compagnie Marocaine des Barytes (BRPM, 22.5%; Norbar Minerals AS, 55%)	Azzouzet-Tidiennit	36,000.
Cement	Asment de Temara (Cimentos de Portugal, 57.4%)	Temara	830,000.
Do.	Lafarge Ciments (Société Nationale d'Investissment, 50%)	Casablanca	2,000,000.
Do.	do.	Meknes	850,000.
Do.	do.	Tamuda	800,000.
Do.	do.	Tangier	350,000.
Do.	Cimenterie de l'Oriental (Holderbank, 51%; private, 35%)	Oujda	1,000,000.
Do.	do.	Ras El Ma	1,200,000.
Do.	Ciments du Maroc (Ciments Fracais, 55.5%)	Agadir	1,100,000.
Do.	do.	Marrakech	1,300,000.
Do.	do.	Safi	650,000.
Cobalt	Compagnie de Tifnout Tiranimine (CTT) [Omnium Nord Africain (ONA), 55.2%; Société Metallurgique d'Imiter (SMI), 20%]	Bou Azzer	150,000 ore, 50,000 concentrate.
Copper	Société Minière de Bou Gaffer (BRPM, 34.2%; SMI, 36%; ONA, 7.6%)	Bleida	50,000 concentrate.
Do.	Société de Développement du Cuivre de l'Anti-Atlas (BRPM, 100%)	Tiouit	4,500 Cu, Au, Ag concentrate.
Fluorspar	Société Anonyme d'Entreprises Minières (ONA, 58%; SMI, 42%)	Meknes	120,000 concentrate.
Gold	Akka Gold Mining Company (ONA, 70%; BRPM, 30%)	Iourim	NA.
Iron ore million metric tons	Société d'Exploitation des Mines du Rif (SEFERIF) (BRPM, 100%)	Nador	12.
Lead	Compagnie Minière de Guemassa (CMG) (ONA, 74%; BRPM, 26%)	Hajar	150,000 Zn concentrate, 32,000 Pb concentrate.
Do.	Compagnie Minière de Touissit (CMT) (Compagnie Royale Asturienne des Mines S.A., Belgium, 50%)	Touissit	73,000 concentrate.
Do.	Société de Développement Industrien et Minière (BRPM, 50%)	Zeida	40,000 concentrate.
Manganese	Société Anonyme Chérifienne d 'Etudes Minières (BRPM, 43%; Compagnie Minière de l'Ogooué SA, 30%)	Quarzazate	130,000 concentrate.
Petroleum refinery products thousand 42-gallon barrels	Société Marocaine de l'Industrie du Raffinage (Corral Morocco Saudi Co., 100%)	Mohammedia	47,000.
Do. do.	Société Chérifienne des Pétroles (Corral Morocco Saudi Co., 100%)	Sidi Kacem	9,500.
Phosphate million metric tons	Office Chérifien des Phosphates (Government, 100%)	Youssoufia	6 concentrate.
Do. do.	do.	Benguerir	6 concentrate.
Do. do.	do.	Khouribga	4 concentrate.
Do. do.	do.	Sidi Chenan	5 concentrate.
Do. do.	do.	BouCraa	6 concentrate.
Salt, rock	Société de Sel de Mohammedia (BRPM, 100%)	Mohammedia	150,000.
Salt, marine	Société Chérifienne des Sels [BRPM, 50%; Société Nouvelle des Salins du Sine Saloum, 50%]	Zima	50,000.
Silver kilograms	Société Metallurgique d'Imiter (SMI) (ONA, 67%; private, 20%; BRPM, 13%)	Near Quarzazate	210,000.
Steel rebar, wire rod	Société Nationale de Sidérurgie (private, 65%)	Nador	480,000.
Zinc	Omnium Nord Africain mine and plant (ONA, 100%)	Guemassa	265,000 concentrate.
Zircon	Agrupacion Minera de Investigaciones SA	Guelmin	NA.

NA Not available.

THE MINERAL INDUSTRY OF

MOZAMBIQUE

By Thomas R. Yager

In recent years, the mineral industry of Mozambique has produced gold and such industrial minerals as bauxite, bentonite and other clays, gemstones, graphite, and salt. The country also has produced coal, natural gas, and such building materials as cement, gravel, marble, and sand. Deposits of asbestos, copper, diatomite, feldspar, fluorspar, guano, gypsum, iron ore, limestone, manganese, mica, nepheline syenite, perlite, phosphate rock, rare earths, silica sand, tantalum, and titanium also are known to occur in Mozambique.

The International Monetary Fund (2001a, p. 34) estimated that Mozambique's gross domestic product (GDP) grew by 3.8% in 2000 compared with 7.3% in 1999 and 11.9% in 1998. In 2000, the economy suffered from the effects of flooding and higher oil prices. After growing 15.1% in 1998 and 19.9% in 1997, the value of output in the mining sector contracted by 4.1% in 2000 and 33.7% in 1999 owing to decreased production of coal and the closure of Mozambique's only graphite mine (table 1). In 1999, manufacturing accounted for 9.6% of the GDP; construction, 8.6%; electricity and water, 2.7%; and mining, less than 1% (International Monetary Fund, 2001b, p. 70).

The U.S. Central Intelligence Agency (2001) estimated that Mozambique's GDP in 2000 amounted to about $19.1 billion at purchasing power parity. In the same year, the per capita income was $1,000.

The value of exported minerals fell to $3.6 million in 1999 from $6 million in 1995. During the same period, exported petroleum products fell to $4.4 million from $4.5 million, and coal exports fell to $300,000 from $500,000 (International Monetary Fund, 2001b, p. 97).

Commodity Review

Metals

Aluminum.—The Mozal aluminum smelter, which used bauxite imported from western Australia as raw material, began operation in the third quarter of 2000. The plant was jointly owned by Billiton plc (47%), Mitsubishi Corp. (25%), Industrial Development Corp. of South Africa Ltd. (IDC) (24%), and the Government of Mozambique (4%). During 2000, a $970-million plant expansion was discussed that would double Mozal's output to 506,000 metric tons per year (t/yr) from 253,000 t/yr (Africa Energy & Mining, 2000b).

A small bauxite mine in Manica Province was operated by E.C. Meikles (Pty.) Ltd. of Zimbabwe. Domestic bauxite resources were estimated to be about 6 million metric tons (Mt) (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 21). Mozambique's bauxite production was exported in 2000 (Mabica, 2001).

Gold.—Mozambique's gold resources were located in lode and placer deposits throughout the country. The Chimezi, the Chua, the Mangota, and the Penhalonga/Revue lode mining areas have resources of at least 3.5 Mt at an average grade of 6.7 grams per ton (g/t) gold. The main placer deposits were found in the Chimezi, the Inhamurra, the Muza, and the Revue Rivers with combined resources of 112 million cubic meters at an average grade of 0.2488 gram per cubic meter (Ruffini, 1998a). Contained gold amounted to nearly 28 metric tons (t) in the placer deposits; and 23 t in the lode deposits.

Recent exploration work by Kenmare Resources plc in Niassa Province identified resources of about 570,000 t at an average grade of 9.9 g/t gold. These resources were found in one vein to a depth of 200 meters. Kenmare suspended exploration pending support from a joint-venture partner (Mining Journal, 2000, Mozambique—Current exploration and development projects, accessed August 31, 2001, at URL http://www.mining-journal.com/MOZAMBIQUE/file7.htm). CODMAT Lda explored for gold at Camulaumba near the Luenha River in southern Tete Province.

Most of Mozambique's gold production was artisanal and not included in official figures. Basic panning and digging operations in Niassa produced 4 t/yr to 5 t/yr of gold. Official exports of gold amounted to 17.4 kilograms (kg) in 2000 and 8 kg in 1999 (Mabica, 2001).

Iron and Steel.—The Maputo Iron & Steel project was a joint venture between Enron Corp. and five steel and engineering companies to build a steel plant in Maputo. Enron held a 50% stake in the project, and the remaining 50% was shared by Duferco SA of Switzerland; Kobe Steel Ltd.; Midrex Technologies, Inc.; Tecnica Internazionale SpA of Italy; and Voest-Alpine Industrieanlagenbau GmbH & Co. of Austria. The plant would produce semimanufactured steel slabs from imported iron ore and have a capacity of 2 million metric tons per year (Mt/yr). The cost of the project was reported to be $1.1 billion; construction was scheduled to start in 2002 (Metal Bulletin, 2000). No plans have been announced to exploit Mozambique's domestic iron ore resources, which were reported to be 254 Mt (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 22).

Titanium and Zirconium.—The Corridor Sands project was based upon 10 deposits of heavy mineral sands near Chibuto in southern Mozambique. Total resources were estimated to be 14 billion metric tons (Gt); the largest deposit has an estimated 8.7 Gt that contains about 300 Mt of ilmenite. Southern Mining Corp. of South Africa (the owner of the project) estimated that the total heavy-mineral grade exceeded 8%. In 2000, Western Mining Corp. of Australia (WMC) acquired majority control of Corridor Sands and a 20% share of Southern Mining; IDC held a 20% interest in Corridor Sands. Production was expected to start in August 2001; WMC hoped to produce 375,000 t/yr of titania slag and high-grade pig iron, rutile, and zircon (Africa Energy & Mining, 2000e).

Resources in the Moma area were reported to be 2,133 Mt containing 63.2 Mt of ilmenite and 15.6 Mt of zircon and rutile;

the ilmenite graded 52% to 55% titanium oxide. In 2000, Kenmare signed a mining licensing agreement with the Government of Mozambique to exploit the Moma mineral sands. The company's feasibility study showed the Moma project to be technically feasible and commercially viable. Kenmare purchased the concentrator and separator plants needed for the mine, which was scheduled to begin production in early 2003. The company planned to produce 625,000 t/yr of ilmenite, 24,000 t/yr of zircon, and 12,500 t/yr of rutile (Kenmare Resources plc, 2001, p. 2, 4-5, 7).

Exploration work by Billiton plc found that the heavy mineral sands at Moebase have a resource of 1.5 Gt that contains 47.3 Mt of ilmenite (Williams de Broë, 1997, p. 5).

Industrial Minerals

Bentonite and Other Clays.—The Boane bentonite deposit was mined by Companhia de Desenvovimento, which was recently privatized and operated by a group of local investors. Exports of processed bentonite amounted to 480 t in 1999 and 172 t in 2000 (Mabica, 2001). Resources of bentonite were estimated to be about 8 Mt; kaolin, 4.4 Mt; and other clays, 18.3 Mt (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 21).

Cement.—The International Cement Review (2001, p. 214) estimated that Mozambique's consumption of cement grew to 400,000 t from 320,000 t in 1998. Cimentos de Portugal, SGPS, SA, held a 51% stake in Cimentos de Mocambique SARL, which was the country's only cement producer. The Dondo, the Matola, and the Nacala plants had a combined production capacity of 600,000 t/yr clinker and 540,000 t/yr cement. Mozambique's cement capacity was expected to double by 2002, and its demand for cement was expected to reach 1 Mt/yr by 2005.

Fluorspar.—Deposits of flurospar were known to occur at Djanguire and Monte Muambe. Resources at the Djanguire deposit were estimated to be about 698,000 t at an average grade of 65% fluorite (CaF_2). Proven resources amounted to 71,000 t; probable resources, 95,000 t; and possible resources, 532,000 t (Afonso and Marques, 1998, p. 68). Grupo Madal SARL and MCM Trading Lda. jointly held a prospecting license for the Monte Muambe deposit. In 1999, Grupo Madal completed detailed field mapping, stream-sediment sampling, mapping of the entire carbonatite complex, and standard mineralogical and metallurgical testing. The company planned to drill and construct trenches and to evaluate such costs as water, power supply, and transportation. Earlier studies estimated resources at Monte Muambe to be 1.42 Mt at a grade of 75% to 81% CaF_2 (European Union and Southern African Development Community, 2000, Project profiles—Mozambique—Monte Muambe fluorite, accessed October 3, 2001, at URL http://www.mines2000projects.com/html/frame_project.htm).

Gemstones.—Mozambique was known to have resources of precious, semiprecious, and ornamental stones, such as agate, amethyst, aquamarine, emerald, garnet, jasper, morganite, rose quartz, tigereye, and tourmaline, particularly in the Mozambique Orogenic Belt. In recent years, the country has produced amethyst from Alto Ligonha; high-quality aquamarine from Macula, Mocuba, Monapo, and Muiane; emerald from Alto Ligonha and Maria; garnet from Cuamba; rose quartz from Alto Ligonha; and tourmaline from Muiane, Nacala, and Naipa. MGM Minerais and Gemas THC Mocambique Ltda. was exploring the possibility of cutting gemstones and opening a gemstone mine (Kane, 1999; Shigley and others, 2000, p. 311, 318, 320-322).

Graphite.—The Ancuabe Graphite Mine in Cabo Delgado Province was placed on care and maintenance in October 1999 by Kenmare owing to a tax dispute between the company and the Government. Kenmare has been attempting to secure the working capital needed to reopen the mine. Graphite resources in Cabo Delgado were estimated to be 30 Mt at a grade of approximately 9.5% graphite. Other graphite deposits were located at Satemua, which has a resource of 5.6 Mt at a grade of 6% graphite (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 32). Mozambique exported 4,084 t of graphite in 1999 (Mabica, 2001).

Limestone.—Resources from the Muanza, the Nacala, and the Salamanga limestone deposits have been exploited for cement production at the Dondo, the Nacala, and the Matola cement plants, respectively. Mozambique's limestone resources were reported to be nearly 39.8 Mt in 1995 (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 32).

Marble.—Marmonte E.E., which was recently privatized, produced and exported marble from Montepuez in Cabo Delgado. Mozambique's marble resources were estimated to be 83 Mt (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 22).

Phosphate Rock.—Phosphate rock resources were estimated to be 274 Mt. Norsk Hydro ASA engaged in exploration at the Evate phosphate deposit in northeastern Mozambique. Evate, which was the country's largest deposit of phosphate rock, has estimated resources of 155 Mt at a grade of 9.8% phosphorus pentoxide (P_2O_5). A residual concentration of apatite ore near Evate has estimated resources of about 9 Mt at a grade of 14% P_2O_5. Other deposits occur at Monte Muambe and Monte Cone N'gose (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 21, 24, 34).

Mineral Fuels

Coal.—Mozambique was reported to have 2.28 Gt of proven bituminous coal reserves and more than 15.8 Gt of identified coal resources. The Moatize deposit has proven reserves and other identified resources of 7,246 Mt; Minjova, 7,080 Mt; Mucanha-Vuzi, 3,561 Mt; and Maniamba, 228 Mt (Ruffini, 1998b). Small amounts of coal were mined from Moatize by state-owned Carbomoc and exported to Malawi. Exports of coal amounted to 29,010 t in 2000 and 20,502 t in 1999 (Alfonso Mabica, Mozambique National Directorate of Mines, written comm., 2001). Coal production at Moatize has been far below capacity owing to the destruction of the rail link between the Moatize Mine and the port of Beira during the civil war. The Government has planned to restore production at the Moatize Mine.

Natural Gas.—The Pande and the Temane gasfields had original gas in place of 85 billion cubic meters and 57 billion cubic meters, respectively. Reserves at Pande, Temane, and

Buzi were reported to be 74 billion cubic meters, 51 billion cubic meters, and 15 billion cubic meters, respectively. The Pande field was exploited on a small-scale basis for domestic consumption. In October, Sasol Ltd. of South Africa signed a contract to build a pipeline between the Pande and the Temane fields. The company would hold a 50% stake in the project, and the Governments of Mozambique and South Africa would hold 25% each. Production of gas would reach a rate of 5.7 million cubic meters per day in 2004; the Temane field would be the first field to go into large-scale production. Roughly 10% of the gas produced from the Pande and the Temane fields would be consumed domestically (Africa Energy & Mining, 2000a, d; Matthews and others, 2001).

Petroleum.—Mozambique produced neither crude petroleum nor refined petroleum products and relied on imports, which were sourced mainly from South Africa. The country consumed an estimated 3.29 million barrels of petroleum products in 2000. Mozambique was promoting offshore exploration for petroleum and natural gas. Recently obtained seismic data indicated that the Mozambique Basin might have notable resources of petroleum (Africa Energy & Mining, 2000c). The Governments of Malawi, Mozambique, and Zimbabwe made plans for a joint fuel refinery in Mozambique with a capacity of 10,000 barrels per day. The project was to be funded by the Government of Iran (Mbendi Information Services, 2000, Mozambique—Oil and gas industry—Overview, accessed August 31, 2001, at URL http://www.mbendi.co.za/indy/oilg/af/ mz/p0005.htm).

Infrastructure

In 1999, Mozambique generated 2,300 gigawatthours (GWh) of electricity, of which 87% was provided by hydroelectric power sources, and 13%, by fossil fuels. In 1999, Mozambique imported an estimated 70 GWh of electricity. In the same year, the country exported 1,900 GWh valued at $62.9 million (International Monetary Fund, 2001a, p. 97). Mozambique had installed capacity of 2,313 megawatts (MW); the Cabora Bassa Dam accounted for 2,075 MW. Another dam was to be built on the Zambezi River with a capacity of 1,200 to 2,400 MW. Mozambique's exploitable potential hydroelectric energy has been estimated to be 14,000 MW (Africa Energy & Mining, 2000d).

Mozambique had about 30,400 kilometers (km) of roads, of which approximately 5,700 km was paved. The rail network covered about 3,100 km. The country had 306 km of crude petroleum pipelines and 289 km of petroleum products pipelines; the pipeline from Beira to Harare carried petroleum products to Zimbabwe. Ports and harbors were Beira, Inhambane, Maputo, Nacala, Pemba, and Quelimane. Navigable waterways covered about 3,750 km (U.S. Central Intelligence Agency, 2001).

Outlook

The International Monetary Fund (2001a, p. 34) predicted that the mining sector would grow by 10% in 2001 and by 15% per year from 2002 to 2005. Construction sector activity was also expected to increase; growth was predicted to be 2% in 2001 and 7% per year from 2002 to 2005. Mozambique's economy was expected to receive a significant boost from the heavy-mineral sands projects, the Maputo Iron & Steel project, and the Mozal smelter. Rising demand for cement would probably lead to greater exploitation of domestic limestone resources. Coal production could increase significantly if the rail link between the Moatize Mine and the port of Beira were restored.

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TABLE 1
MOZAMBIQUE: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000
Aluminum:						
Bauxite		11,459	8,218	6,130	7,883 r/	8,130
Metal, refined		--	--	--	--	53,800
Cement, hydraulic	thousand tons	180	220	260 r/	270 r/	310 e/
Clays, bentonite:						
Crude		11,051	12,625	10,448	10,828 r/	16,144
Processed		NA	NA	NA	360	274
Coal, bituminous		40,000	60,000 r/	60,000 r/	8,573 r/	16,115
Gemstones, semiprecious:						
Cut stones, all types	carats	2,663	5,168	5,303	3,500 r/ e/	3,400 e/
Rough stones	kilograms	1,862	1,091	1,465	1,000 r/ e/	1,000 e/
Gold 4/	do.	67	6	17	19 r/	23
Graphite, concentrates		3,283	5,125	5,889	4,007 r/	--
Gravel and crushed rock e/	cubic meters	120,000	123,532 5/	282,832 5/	290,000 r/	285,000
Limestone, for cement e/	thousand tons	240,000	290,000	340,000	360,000	410,000
Marble:						
Block	do.	744	251	117	120 r/ e/	120 e/
Slab	square meters	18,232	13,820	2,736	2,800 r/ e/	2,800 e/
Natural gas e/	million cubic meters	--	--	60 5/	55	55
Salt, marine e/		60,000	60,000	60,000	40,000 r/	38,000

e/ Estimated. r/ Revised. NA Not available. -- Zero.

1/ Estimated data are rounded to no more than three significant digits.

2/ Data available through August 31, 2001.

3/ In addition to the commodities listed, construction materials (other clays, sand and gravel, and stone) were produced. Output, however, is not reported quantitatively and information was insufficient to make reliable estimates.

4/ Does not include artisanal gold, which was estimated to be roughly 4,000 to 5,000 kilograms per year.

5/ Reported figure.

THE MINERAL INDUSTRY OF

NAMIBIA

By George J. Coakley

Namibia is located on the southwestern coast of Africa between South Africa and Angola. The 825,418-square-kilometer country had an estimated population of 1.8 million in 2000 and a gross domestic product (GDP) per capita of about \$4,300[1] based on purchasing power parity. In 1999, the mineral industry of Namibia provided about 43% of exports and 20% of the country's GDP (U.S. Central Intelligence Agency, Namibia—Economy, World Factbook 2000, accessed December 5, 2000, at URL http://www.odci.gov/cia/publications/Factbook/geos/ wa.html#Econ). Diamond remained the most important sector of the mining industry followed by uranium, for which Namibia ranked as the world's fourth largest producer. Namibia was also the second largest producer of salt in Africa. Other important mineral products included copper, dimension stone (granite and marble), fluorite, gold, lead, silver, and zinc.

Government Policies and Programs

The principal legislative documents that govern mineral and energy development in Namibia are available on the Ministry of Mines and Energy website at URL http://www.mme.gov.na/mines/index.html.

The basic mining law is the Minerals (Prospecting and Mining) Act, No. 33 of 1992, which took effect on April 1, 1994. An accompanying Mining (Taxation) Act set forth revised fiscal and royalty provisions for the industry. The Mining Act was still being refined, and additional amendments were under consideration during 2000.

The system of taxation on diamond mining consisted of three separate taxes—on income, on diamond profits, and on diamond export duties. The export duty has now been replaced by a 10% royalty. The overall income tax on diamond mining companies is levied at the rate of 55% of taxable income plus a surcharge of 10% on the market value of diamonds shipped and sold. The Income Tax Act provides that this 10% surcharge paid as diamond profits tax be credited against the income tax payable by diamond mines. A new Diamond Law was enacted on September 30, 1999, and came into effect on April 1, 2000. The Diamond Law will regulate and control the holding, transport, and further processing of diamonds through a system of licences approved by the Diamond Commissioner. The act also establishes a Diamond Board, a Diamond Board Fund, and a Diamond Evaluation Fund. Diamond exploration and mining licensing will continue to be administered by the Office of the Mining Commissioner.

The fiscal regime for oil exploration companies consists of three principal elements—an income tax and an Additional Profits Tax levied in terms of the Petroleum (Taxation) Act, No. 3 of 1991, and a 12.5% royalty levied in terms of the Petroleum (Exploration and Production) Act, No. 2 of 1991. The Petroleum Laws Amendment Act 24 of 1998 amended the 1991 Petroleum (Exploration & Production) Act, No. 2, the 1991 Petroleum (Taxation) Act, and along with the Model Petroleum Agreement of September 1998 were designed to provide additional incentives to attract new foreign investment. The Petroleum Laws Amendments Act of 1998 introduced a number of new incentives, which included reduction of royalties on the value of oil and gas production to 5% from 12.5%, a reduction of the petroleum income tax from to 35% from 42%, allowance for full annual writeoff for exploration and operating expenditures, and the introduction of three-tiered "additional profits tax" that will become effective only when licensees earn an after-tax real rate of return of 15%, then 20%, and finally after a 25% return (Abraham, 1998).

The Foreign Investment Act of 1990 offers prospective investors a package of incentives, such as repatriation of profits, security of title and tenure, availability of foreign exchange, international arbitration, and fair compensation in case of expropriation.

The Ministry of Mines and Energy was responsible for making and enforcing policies related to minerals and energy. Within the ministry and attached to the Permanent Secretary are the Diamond Board, the Mining Advisory Board, and the National Energy Council, all of which have Government and private-sector representation. Namibia Petroleum Co. and NamPower, which is the Namibia national electric utility, also are part of the ministry. The four main directorates in the ministry are Geological Survey, Mining, Energy, and Administration and Finance. The three main functions of the Mining Directorate evaluate and control mineral license applications, ensure adequate safety standards in mining operations, and collect, analyze, and disseminate production statistics. An Ancillary Rights Commission was set up by the Ministry to handle dispute arbitration.

The Mine Health and Safety Regulations was in its 10th draft during 2000.

Environmental Issues

As one of the major sectors of the economy, the mining industry plays an active role in funding conservation awareness and environmental education programs. Some of Namibia's mines are located in or close to the Namib, which is one of the world's oldest deserts and is host to a number of extremely rare species of plant and animal life. Because this unique habitat is one of Namibia's most valuable tourist assets, the ecosystem is closely monitored by local and international scientific and conservation communities. The competition for limited water resources between human and industrial uses will remain an ongoing environmental concern for the country.

In addition to the desert, Namibia possesses several "wetland" areas of international repute, particularly the Etosha Salt Pan, the Kavango/Caprivi region, the Walvis Bay lagoon, and Sandwich Harbor, as well as the mouths of the Kunene and the

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[1] Where necessary, values have been converted from Namibian dollars (N\$) to U.S. dollars at the rate of N\$7.1=US\$1.00 for 2000 and N\$6.11=US\$1.00 for 1999.

Orange Rivers. The fragile nature of these desert and wetland ecosystems is a concern when considering any infrastructure projects, such as railroads or pipelines between Walvis Bay and northeastern Namibia and Botswana. Comprehensive studies have been undertaken to assess the effects of marine mining operations with respect to these areas and, in particular, the changes in tidal patterns caused by the disposal of fine sediments during offshore mining. In addition, work is being carried out to assess the extent of any interaction between marine mining activities and the local fishing (mainly lobster) and mariculture (oyster and mussel production) industries and to provide information that will assist these industries to develop and coexist with minimal adverse effects upon each other.

Production and Trade

The production statistics in table 1 were compiled mostly from data provided by the Namibia Ministry of Mines and Energy in response to the U.S. Geological Survey's annual minerals questionnaire and from company reports. Production of most mineral commodities significantly increased in 2000 compared with that of 1999; the exceptions were diamonds and fluorspar, which declined by 5% and 7%, respectively. With limited opportunities for new markets, uranium output has remained relatively constant at around 3,200 metric tons (t) from 1998 to 2000. In 2000, the value of mineral production was approximately $63.23 million—diamond, $515.16 million; uranium oxide, $75.37 million (based on a market price of $ 23.55 per kilogram); gold, $22.29 million; zinc, $19.97 million; copper $8.14 million; fluorite, $4.95 million; lead, $2.99 million; and silver, $2.56 million. The value of granite, marble, salt, and semiprecious stones amounted to $1.8 million. The value of production approximately equals the value of exports. In 1999, the total value of all merchandise exports was $1.4 billion. Total imports, chiefly food and petroleum products, totaled $1.5 billion in 1999.

Commodity Review

Metals

Copper.—In March 2000, which was nearly 2 years after its abrupt closure, the Government announced that the Tsumeb copper smelter and the Khusib Springs, the Kombat, and the Otjihase copper-lead-silver mines would reopen. A new company, Ongopolo Mining and Processing Limited, was formed as a partnership between former managers of Tsumeb Copper Limited (TCL) and the National Union of Namibian Workers (NUMW) with financing from a $5.6 million investment by the Government Institutions Pension Fund and a $4.2 million loan from a private investor. The General Secretary of NUMW was appointed as Chairman of Ongopolo (Werner Menges, March 15, 2000, Ongopolo to take the ball and run with it, The Namibian [Windhoek], accessed July 7, 2001, at URL http://www.namibian.com.na/Netstories/2000/March/News/with.html). "Ongopolo" is the word for copper in the local Otjiwambo language.

Mining was restarted at the Kombat Mine and the high-grade Khusib Mine in April and at the Otjihase Mine in November. Following a $2 million refurbishment, the old Tsumeb copper smelter came back into production in June 2000. Through the end of March 2001, the northern mines (Kombat and Khusib) produced 200,000 t of copper ore, and the Otjihase Mine, 125,000 t of copper ore. At full production, the northern mines were expected to produce at a rate of 24,000 metric tons per month (t/mo) of ore, and Otjihase, at 60,000 t/mo. A new ore block at Otjihase had a projected life span of 5 to 7 years. Through the end of March 2001, the Tsumeb smelter produced 20,200 t of blister copper; 7,000 t of blister was produced from Ongopolo concentrates, and 13,200 t of blister copper, from imported concentrates (Werner Menges, April 15, 2000, Ongopolo mines revival on course, The Namibian [Windhoek], accessed July 7, 2001, at URL http://www.namibian.com.na/Netstories/2001/April/News/with.html).

While seeking investors for TCL, the Government had reported remaining measured mineral reserves at Khusib to be 119 million metric tons (Mt) at a grade of 10.06% copper, 1.82% lead, and 584 grams per metric ton (g/t) silver; measured reserves at Kombat, 1.4 Mt at a grade of 3.16% copper, 2.67% lead, and 584 g/t silver; inferred reserves at Kombat, 5.3 Mt at a grade of 2.5% copper and 18.7 g/t silver; measured reserves at Otjihase, 2.1 Mt at a grade of 1.96% copper, 17.2% lead, and 7 g/t silver; and inferred reserves at Otjihase, 8.5 Mt at a grade of 1.8% copper, 12.8% lead, and 7.6 g/t silver (New Africa.com, [1999], Tsumeb assets for sale, accessed December 1, 1999, at URL http://www.newafrica.com/investments/projects/namibia/miningextraction.asp).

Development of the Haib copper deposit remained on hold during 2000 pending more favorable market conditions. The original partners in Namibia Copper Joint Venture (Pty.) Ltd. were Namibia Copper Mines Inc. (80%) of the United States and Great Fitzroy Mines NL (20%) of Australia. When Namibia Copper Mines defaulted in its farm-in agreement in 1998, its interest in the project reverted to Great Fitzroy. During 1999 and 2000, Namibia Copper Mines wrote down more than $8 million in losses on the Haib project and also changed its corporate name to American Southwest Holdings Inc. (American Southwest Holdings Inc., May 9, 2001, Quarterly report to U.S. Securities and Exchange Commission for period ending September 30, 2000, accessed August 6, 2001, at URL http://www.sec.gov/Archives/edgar/data/1001516/ 000102385601500010/0001023856-01-500010.txt). Great Fitzroy Mines also changed its corporate name to Copper Mines and Metals Ltd. During 2000, Copper Mines and Metals reassessed the mineral and metallurgical potential of the oxide resource within the Haib porphyry copper deposit to support a scaled-down development. The company also applied for renewal of its exploration license 2152 on the property (Copper Mines and Metals Ltd., [2001], Annual report for 2000, accessed August 6, 2001, at URL http://www.coppermines.com.au/cop00ar.htm).

Lead and Zinc.—In September, Anglo American plc initiated construction of its new $454 million Skorpion zinc mine and refinery project, which is located 25 kilometers (km) north of Rosh Pinah and 85 km northeast of Oranjemund. In 1999, Anglo American had bought Reunion Mining plc for $82 million, thus regaining a 100% interest in the project. Skorpion will produce 150,000 metric tons per year (t/yr) of zinc during a mine life of at least 15 years. First production was planned in the second quarter of 2003. The open pit mine will be based on reserves of 21.4 Mt at a grade of 10.6% zinc. The unusual zinc silicate and carbonate mineralogy will be treated by a direct acid leach of the ore, solid liquid separation, solvent extraction, and electrowinning to produce special high-grade zinc. The company was coordinating with the nearby Rosh Pinah zinc operation to optimize the use of local power, water, and port facilities at Luderitz. Although the mining operation is subject to normal taxes and royalties, the refinery has been granted an Export Processing Zone status and will be tax free (Anglo American plc, September 7, 2000, Anglo American plc invests US$454 million in Skorpion zinc mine in Namibia, accessed August 6, 2001, at URL http://www.angloamerican.co.uk/news_detail.asp?news_item_number=80026).

Gold.—AngloGold (Namibia) Pty. Ltd. (formerly Erongo Mining and Exploration Co. Ltd.) held a 100% interest in the Navachab gold mine near Karibib following the 1999 acquisition of the 20% interest in Navachab held by Inmet Mining Corp. and the 10% interest held by Randgold Resources Ltd. Navachab accounted for more than 95% of the total national gold production. The Navachab deposit is within the Damara greenstone belt with the bulk of the gold mineralization occurring within a skarn zone. In 2000, production was 2,395 kilograms (kg) compared with 2,009 kg in 1999. The average grade of ore mined from the open pit in 1999 was 1.46 g/t. During 2000, AngloGold decided to proceed with the extension of the western side of the pit, which will extend the life of the mine from 2003 to 2005. The company has abandoned plans to extend the minelife to 2012 but did proceed with a feasibility study on substantially increasing mining rates and extending the life of the mine to 2009. A labor disagreement, pursuant to the Ministry of Labour declaring the mine a "continuous operation" was resolved with the union by an agreement on Sunday and public holiday payments (Christoff Maletsky, August 22, 2000, Navachab plans ditched, The Namibian, accessed August 5, 2001, at URL http://www.namibian.com.na/Netstories/2000/August/News/009ADC4AC2.html).

Tantalum.—Reefton Mining N.L. of Australia held seven exploration licenses in what they referred to as the Erongo base-metals, gold, and tantalite project in northwestern Namibia. The concessions included several pegmatite zones previously mined for tantalite, tin, and tungsten. The sharp rise in tantalum prices during 2000 caused a renewed interest in these old pegmatite mining areas (Reefton Mining N.L., [2001], Annual report for 2000, accessed August 8, 2001, at URL http://www.erd.pair.com/reeftonmining/rtm00ar.htm).

Uranium.—Rössing Uranium Ltd., which was owned by Rio Tinto plc of the United Kingdom (56%), was the fifth largest producing uranium mine in the world; it contributed 3,200 t of uranium oxide, or 7.8% of world supply, in 2000 (Uranium Information Center, June 2001, World uranium mining, Nuclear Issues Briefing Paper 41, accessed August 1, 2001, at URL http://www.uic.com.au/nip41.htm). Faced with an extended weak market, Rössing continued to operate at about 75% of capacity; it maintained production at around 3,200 t of uranium oxide for 4 of the past 5 years. In 2000, production was based on a mine production of 24.1 Mt of material, of which 11 Mt of ore was milled. Exploration drilling continued to define the Rössing ore body further, and construction began on the pilot radiometric ore sorting plant, which had been designed to increase uranium production and to improve cost performance by enhancing the mine feed grade for the processing plant. The sorting plant has the potential to remove about 25% of the total rock mass by eliminating low-grade rocks. Rössing has played an important part in the Namibian economy by expending more than $80 million per year in Namibia on wages, taxes, and goods and services and by accounting for about 12% of mineral exports and about 5% of all other exports (Rössing Uranium Ltd., [undated], RB 2000—Overview of operations, accessed August 5, 2001, at URL http://www.rossing.com/operate.htm).

Industrial Minerals

Diamond.—Exploration and development of new diamond fields, particularly offshore, remained active in 2000 and demonstrated the potential to expand this $25 million sector of the Namibian mineral economy. Diamond accounted for nearly 37% of total exports and 10% of GDP. In 2000, production of diamond decreased by 6% to 1.54 million carats; slightly more than one-half came from marine sources. Namdeb Diamond Corp. (Pty.) Ltd., which was established in 1994 as a 50-50 joint venture between De Beers Centenary AG and the Namibian Government, accounted for 1.32 million carats of this output. Namdeb operated the following license areas: Atlantic 1, Bogenfels, Douglas Bay, Elizabeth Bay, Mining Area 1, and Orange River. Located in the Sperrgebiet (forbidden territory), these six areas cover a strip of land that runs from the north bank of the Orange River to 26 degrees South. The 130-km-long strip extends up to 65 km into the Atlantic Ocean and inland for 100 km. In 2000, Namdeb stripped 24.8 Mt of waste material and treated 23.5 Mt of ore from land-based operations to recover an average of 2.8 carats per 100 t valued at $322 per carat. Marine mining operations in Atlantic 1 were conducted by De Beers Marine Namibia (Debmarine), which was controlled by De Beers (70%) and Namdeb (30%). Debmarine maintained a fleet of four mining vessels and two prospecting vessels. Recovery from marine mining in the Atlantic 1 license area in 2000 amounted to 570,000 carats from material that averaged 2.8 carats per 100 t valued at $298 per carat. De Beers reported a remaining mine life of 20 years at current (2000) production rates that are based on probable total (land plus marine) reserves of 59.4 Mt at a grade of 1.5 carats per 100 t, indicated total resources of 73.6 Mt at a grade of 2.3 carats per 100 t, and inferred total resources of 301.7 Mt at a grade of 1.5 carats per 100 t for a combined reserves and resources of 16.2 million carats of diamond (De Beers Group, [undated], Namdeb—Operations, accessed August 6, 2001, at URL http://www.debeersgroup.com/operations/minesNamdeb2000.asp).

In November, De Beers signed a new agreement with the Government to extend the exclusive Namdeb sales contract with the De Beers' Diamond Trading Company (DTC) (formerly Central Selling Organization) for another 5 years beginning January 1, 2001. De Beers also committed to supporting the launch of a second value-added diamond-cutting facility in Namibia in addition to Namdeb's Namgem cutting plant at Okahandja, which produced about 3,500 finished diamond stones per year. Both cutting plants would be supplied diamond rough by the DTC under terms of the agreement (De Beers Group, November 29, 2000, Government of the Republic of Namibia and De Beers Centenary AG, accessed August 6, 2001, at URL http://www.debeersgroup.com/archive/press/mr20001129-1.asp).

Following its acquisition of 92.5% of Ocean Diamond Mining Holdings Ltd. (ODM) for $60 million in late 1999, Namibian

Minerals Corp. (Namco) became the second largest diamond producer after Namdeb. Namco, which was a United Kingdom-based firm listed on the Namibian and the Toronto stock exchanges, began commercial mining of diamonds in February 1998 on its offshore Koichab prospect in Luderitz Bay. It operated three former ODM airlift mining vessels, the *Ivan Prinsep*, the MV *Namibian Gem*, and the *Oceandia*, and two Namco mining vessels, MV *Kovambo* and MV *Ya Toivo*, which supported the Namco-developed underwater *NamSSol I* (*Nam 1*) and *NamSSol II* (*Nam 2*) seabed mine-crawlers with a combined capacity of around 400,000 carats per year.

During 2000, Namco treated more than 1 million cubic meters of submarine sediments and produced 221,000 carats of diamond with an average sales price of $176 per carat compared with 273,700 carats of diamond with an average sales price of $151 per carat in 1999. The higher average price in 2000 was attributed to the larger (0.38-carat) stones recovered from ODM's Mining License 36. During 2000, Namco invested $50 million in constructing the *Nam 2* seabed crawler and conversion of its support vessel, *MV Ya Toivo*, which were launched in December; on the 3-month renovation of the MV *Namibian Gem*; and on development of a new exploration tool and conversion of it support vessel MV *Zacharias*. In January 2001, Namco suffered a major setback when the *Nam I* was damaged in an underwater landslide. Faced with the loss of significant cash flow, the company suspended all mining operations in February 2001 and was seeking outside financial help to rescue it from liquidation (Namibian Minerals Corp., May 22, 2001, Namibian Minerals Corp. (Namco) announces fourth quarter and full year 2000 results, accessed August 5, 2001, at URL http://infomine.com/index/pr/Pa070522.pdf).

In October, Diamond Fields International Ltd. (DFI) announced its plans to proceed with its $28 million Sea Diamonds Project on its Luderitz offshore diamond mining concessions, which included the Diaz Reef and the Marshall Fork areas. DFI used the results of contract sampling and test mining by Debmarine's mining vessel *MV Coral Sea* as a basis for the feasibility study completed in September. Resource estimates within the Diaz Reef and the Marshall Fork areas included indicated resources (probable reserves) of 5.03 million cubic meters of sediment at an average grade of 0.18 carat per cubic meter that contains 896,200 carats of diamond and inferred resources of 1.08 million cubic meters of sediment at an average grade of 0.19 carat per cubic meter that contains 209,800 carats of diamond. A 5.8-year mine life could be sustained by exploiting only the probable reserves, and a 7-year mine life, by the further exploitation of the inferred resources. Mining will be at the rate of 873,000 cubic meters per year. The diamond found within the Sea Diamonds Project consist of more than 95% gem-quality stones valued at $150 to $200 per carat based on August 2000 market prices (Diamond Fields International Ltd., September 12, 2000, Positive Sea Diamonds feasibility study completed, accessed August 8, 2001, at URL http://www.diamondfields.com/s/NewsReleases.asp?ReportID=15032). DFI received a 15-year mining license from the Government in February 2001 and in March 2001 announced a joint venture with the Trans Hex Group Ltd. to begin mining at the Sea Diamonds project within 8 months following Government approval of the joint venture. DFI will contribute the mining license, and Trans Hex, two air-lift mining vessels to the joint venture (Diamond Fields International Ltd., March 6, 2001, Diamond Fields and Trans Hex sign joint venture agreement, accessed August 8, 2001, at URL http://www.diamondfields.com/s/NewsReleases.asp?ReportID=20327).

Trans Hex International Ltd. (the Canadian diamond exploration subsidiary of Trans Hex Group of South Africa) managed the exploration on Block 9 of its Northbank, Orange River, property on behalf of Northbank Diamonds Ltd. (a 50-50 joint venture between Trans Hex International and Lazare Kaplan International Inc. of the United States). Based on 1997 drilling, the Northbank property had a drill indicated resource of 30 million cubic meters of diamond-bearing gravel deposited in a 4-km by 900-meter paleochannel. A dispute with the owner of the surface rights at Northbank has been under litigation and forced the suspension of exploration since early 1998, with the next hearing of the High Court of Namibia set for February 2001. Meanwhile, Trans Hex International continued parallel exploration for diamonds on its Skeleton Coast Project and conducted geophysical and sampling programs during 1999 and 2000. In partnership with Terradex (Pty.) Ltd., Trans Hex International was providing exploration funds for the Skeleton Coast Project to earn a 90% farm-in interest in Hoanib Diamonds (Pty.) Ltd. (the joint-venture company) (Trans Hex International Ltd., [undated], Trans Hex International Ltd.—Projects, accessed August 10, 2001, at URL http://www.transhex.com/s/Projects.asp).

Other companies active in diamond exploration during 2000 included Mount Burgess Gold Mining Co. NL and Kimberlite Resources Pty. Ltd., both of Australia. Both continued their geophysical and heavy-mineral concentrate sampling exploration for diamond-bearing source-rock kimberlites in the Tsumkwe region in northeastern Namibia near the Botswana border. Work by Mount Burgess during 2000 identified 18 potential kimberlite targets for drilling; these included the Khabi and the Nyae Nyae garnet anomalies (Mount Burgess Gold Mining Co. NL, February 19, 2001, Tsumkwe diamond project—Namibia, accessed August 8, 2001, at URL http://www.mountburgess.com/Announcements.html#19feb). Reefton Mining also held three exploration licenses for diamond that covered 200 km of coastline beaches along the Skeleton Coast. In August, Nora Exploration Inc. of Canada changed its corporate name to Afri-Can Marine Minerals Corp. Afri-Can held a controlling interest in 28 concessions that measured 26,500 square kilometers off the coast of Namibia in two main areas; the Northern Blocks, which is located northwest of Hottentot Bay; and the Southern Concessions (Namibian Gemstones Block), which is located southwest of Elizabeth Bay. The company was continuing with geophysical and selective grab sampling exploration during 2000 and 2001 (Afri-Can Marine Minerals Corp., 2000, Diamond concessions, accessed August 1, 2001, at URL http://www.afri-canmarine.com/concessions.shtml).

Fluorspar.—Okorusu Fluorspar (Pty.) Ltd. completed its $4 million expansion to increase capacity to 80,000 t/yr of acid-grade fluorspar in 2000. Okorusu produced 66,129 wet metric tons of fluorspar in 2000 and exported 67,393 wet metric tons, to Solvay AG of Germany (its parent company). Okorusu contracted to deliver 80,000 wet metric tons of captive production to Solvay in 2001 (Mark Dawe, Chief Geologist, Okorusu Fluorspar (Pty.) Ltd., oral commun., 2001).

Gemstones.—In December, Offshore Development Co.

(25%) and Namdiamonds Inc. (75%) of the United States signed a joint-venture agreement that formed the Namibia Gemstones Development Co.; a $3.9 million gem cutting and polishing plant will be built at Keetmanshoop. The new company will provide training and marketing assistance to small-scale miners. Cut amethysts, garnets, topaz, and tourmaline will be targeted for export (Namibian, December 6, 2000, Namibia's offshore development company seals gem deal with US, accessed August 8, 2001, at URL http://newafrica.com/news/mining/articlepg1.asp?ID=6230).

Salt.—In 2000, production of industrial and refined sodium chloride salt increased by 8% to nearly 543,000 t (table 2). Salt and Chemicals (Pty.) Ltd., which was the primary producer, accounted for more than 80% of national production.

Mineral Fuels

Namibia was import dependent for most of its energy needs with no domestic production of coal, gas, or oil. The hydroelectric dam at Ruancana provided 249 megawatts (MW) of power, and an additional 600 MW was imported from South Africa under arrangements with Eskom and the South African Power Pool. The Third Petroleum Licensing Round for bidding on open-exploration acreage that was held in October 1998 received no bids. The country's hopes for meeting future energy requirements rested on development of its hydroelectric potential and of extensive known offshore gas reserves. Shell Exploration and Production Namibia B.V. (75%), Texaco Namibia Resources (15%), and Energy Africa Ltd. (10%) held the rights to the offshore Kudu gasfield. The Government and Shell have been examining the potential for developing this resource for more than 5 years, but have been unable to work out the right combination of financing and supporting projects to justify the multibillion dollar investment required for its development.

Outlook

The long tradition of mining in Namibia was given a substantial renewal in 2000 with the announced development of the Skorpion zinc project, the reopening of the Tsumeb mines and smelter, and the continued success of offshore diamond exploration and development. These successes are encouraging further exploration for base metals and diamond. Such new mine developments, as well as the potential for new value-added manufacturing, metal-processing, and gemstone cutting and polishing industries, should keep the mineral sector a central part of the economy of Namibia for the foreseeable future. The Government's ability to attract new investment to harness the natural gas and hydroelectric power potential of the Kunene River will strongly influence future economic growth. In the longer run, greater development of regional transportation infrastructure in northern Namibia, which was stimulated by the completion of the recent Trans-Kalahari and Trans-Caprivi Highways, could make Walvis Bay a significant export route for new mineral developments in Angola and in the landlocked countries of Botswana and Zambia. With a climate that is among the driest in the world, Namibia will continue to deal with the lack of water resources as a constraint on development.

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Major Publications

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Geological Survey of Namibia, 1992. The Mineral Resources of Namibia, 598 p.

TABLE 1
NAMIBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
METALS						
Antimony, sodium antimonate (47% Sb):						
Gross weight		16	--	--	--	--
Sb content		8 e/	--	--	--	--
Arsenic, white, 99% arsenic trioxide		1,559	1,297	175	--	--
Cadmium metal, refined		14	2	--	--	--
Copper:						
Mine output, concentrate (26% to 28% Cu):						
Gross weight		57,095	66,879	22,819	--	18,597
Cu content		14,845	17,879	7,500 r/	--	5,070
Metal, blister 2/		16,659	24,997	8,014	--	13,488
Gold	kilograms	2,145	2,417	1,882	2,005 r/	2,456
Lead:						
Mine output, concentrate:						
Gross weight		58,197	32,378	24,273	18,653 r/	22,754
Pb content		15,349	13,577	13,568	9,885 r/	12,115
Metal, refined, primary 2/		8,588	1,530	236	--	--
Manganese, mine output, concentrate (44% Mn):						
Gross weight		92,647	39,671	--	--	--
Mn content		40,765	17,455	--	--	--
Silver, mine output, Ag content of concentrate	kilograms	42,352	41,000	22,670	9,670	16,669
Uranium, U_3O_8 content of concentrate		3,188	3,775	3,257	3,171	3,201
Zinc, mine output, concentrate (49% to 54% Zn):						
Gross weight		69,689	72,816	78,617	70,620 r/	75,747
Zn content		35,873	39,658	42,274	35,140 r/	40,266
INDUSTRIAL MINERALS						
Cement e/		50,000	100,000	150,000	150,000	150,000
Diamond:						
Gem e/	thousand carats	1,402	1,345 e/	1,394 e/	1,633 r/	1,542
Industrial e/	do.	--	71 e/	73 e/	-- r/	--
Total	do.	1,402	1,416	1,467	1,633 r/	1,542
Fluorspar, acid grade (97% CaF_2)		32,285	23,160	42,139	71,011 r/	66,129
Gypsum		--	--	2,596	1,250 e/	588
Lithium minerals:						
Amblygonite		46	75	--	--	--
Lepidolite		355	275	--	--	--
Petalite		1,571	669	--	--	--
Total		1,972	1,019	500	--	--
Salt		355,868	492,780	507,361	503,479 r/	542,948
Semiprecious stones:						
Agate		150	175	161	95	96
Amethyst	kilograms	19	23	--	--	4,850
Chrysocolla	do.	--	--	900	-- r/	--
Garnet	do.	--	5	429	-- r/	134
Quartz, crystal e/		15	--	--	--	--
Pietersite		--	--	--	--	20
Rose quartz		190	220	454	-- r/	74
Sodalite		383	1,598	--	429 r/	457
Tourmaline	kilograms	437	53	--	--	390
Stone:						
Dolomite		5,401	7,635	7,940	8,000 e/	--
Granite		5,218	6,675	6,665	5,866 r/	7,222
Marble		12,673	13,743	9,020	11,221 r/ e/	24,426
Sulfur, pyrite concentrate:						
Gross weight (49% to 51% S)		90,735	94,585	28,174	--	11,967
S content		45,338	46,476	12,855	--	5,704
Wollastonite		248	194	267	347	441

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through November 30, 2000.

2/ Includes products of imported concentrate.

THE MINERAL INDUSTRY OF

NIGERIA

By Philip M. Mobbs

Nigeria remained Africa's largest oil producer in 2000. According to data compiled by the U.S. Department of Energy (2001a), Nigeria ranked 11th in the production of crude petroleum and condensate by volume with about 3% of world production. In 2000, the nation's gross domestic product was estimated to be $41.1 billion compared with $34.8 billion in 1999. Most of this increase could be attributed to the surge of international oil prices in 2000. The oil sector, which was the cornerstone of the Nigerian economy, provided most Government revenues and accounted for most of the country's export earnings.

The Government had a number of programs designed to attract local and foreign investments in the development of the nonfuel minerals sector and to broaden the country's industrial base; the country's reputation for civil strife, corruption, environmental degradation, fraud, poor infrastructure, and political uncertainty, however, continued to temper international investors' interest in most projects (Finance Africa, 1997; Metal Bulletin, 1997; Ayittey, 1998; Rupert, 1998; Corzine, 2000; Oil & Gas Journal, 2000; Yakubu Lawal, December 24, 2000, Oil companies ordered to Nigerianise operations, accessed December 25, 2000, at URL http://www.ngrguardiannews.com/news2/nn807302.html; United Nations Development Programme, March 27, 1992, Fourth country programme for Nigeria, accessed July 1, 1998, at URL http://www.undp.org/undp/rba/country/cp/3087j.htm). The civil unrest associated with the adoption of Islamic Sharia law in many of the northern States added uncertainty to international mineral projects in northern Nigeria.

Mineral resource companies that operated in Nigeria had to cope with local expectations that the companies should provide extensive physical and social infrastructure despite the infrastructure-building efforts of Government agencies, such as the defunct Oil Mineral Producing Areas Development Commission (OMPADEC), which was formed in 1992 to funnel oil revenues back to the oil-producing communities primarily through public infrastructure programs (Ikenna Nwosu, November 1, 2001, Host communities as a potential disincentive to mineral development, accessed November 1, 2001, at URL http://www.ngrguardiannews.com/business2/bn838204.htm). Attacks on oil facilities were the preferred method to draw attention to notional injustices and real problems (Oil & Gas Journal, 2000). In 2000, the Nigerian Navy was deployed to escort commercial vessels in the Niger Delta. The movement of the focus of oilfield development farther offshore could reduce future opportunities for armed assaults on oil production facilities and personnel.

Government Policies and Programs

The Mining and Minerals Decree No. 34 was enacted in 1999. The new law provides for 3-year tax holidays, exemption from customs duties for mining equipment, convertibility of foreign currency, and free transferability of funds. It also reaffirms that all mineral rights are held by the Federal Government. During 2000, however, reallocation of mineral rights to the individual producing States was debated in the national legislature.

The Ministry of Solid Minerals Development is involved in the promotion, exploration, and development of Nigeria's solid minerals. The Department of Petroleum Resources concerns itself with the oil and natural gas segment of the mineral industry. The Ministry of Power and Steel administers the iron and steel sector. Environmental regulations are administered by the Federal Environmental Protection Agency and the Department of Petroleum Resources. The OMPADEC, which withered away in 1999, in theory had received 3% of the national oil revenue to distribute to the oil-producing States. Disputes concerning distribution of funds resulted in the guarantee in the 1999 Constitution that 13% of national oil revenue was to be paid to oil-producing States. Payments began in 2000; however, legal challenges suspended payments by July.

A Government-mandated fuel-price hike in June 2000 resulted in a 5-day nationwide strike. The price of gasoline was raised to $0.29 per liter, diesel fuel to $0.27 per liter, and kerosene to $0.26 per liter. The strike ended after the Government agreed to reduce fuel prices. The new price of gasoline was lowered to $0.21 per liter, and kerosene returned to its original $0.16 per liter.

Trade

In 2000, mineral fuel exports accounted for about 99% of total exports. The value of all Nigerian exports in 2000 was $20.4 billion; this was up from $11.9 billion in 1999. Oil exports were valued at $19.5 billion in 2000 compared with $11.4 billion in 1999. Liquefied natural gas exports were valued at $623 million in 2000 compared with $322 million in 1999. With exports of 319 million barrels of oil to the United States during 2000, Nigeria was America's fifth largest supplier of crude petroleum (U.S. Energy Information Administration, 2001b-i).

Commodity Review

Metals

Aluminum.—Schemes for the reopening of the 193,000-metric-ton-per-year (t/yr)-capacity smelter of Aluminium Smelter Co. of Nigeria Ltd. (ALSCON) at Ikot Abasi were frequently announced; resumption of operations at the 70% state-owned facility, which had closed in June 1999, however, remained restrained by the lack of funding. For most of 2000, negotiations were underway for the privatization of ALSCON and for a new natural gas fuel contract for the smelter (Metal Bulletin, 2000b, g, i-k; Mining Journal, 1999, 2000; Tola Akinmutumi, January 4, 2000, Aluminium producers seek equity participation in ALSCON, accessed January 4, 2000, at URL http://www.ngrguardiannews.com/business2/

bn772302.htm; Josiah Emerole, February 4, 2000, FG set to complete ALSCON—Approves N6.3b for Escravos dredging, others, accessed February 7, 2000, via URL http://www.postexpresswired.com; Guardian, January 3, 2001, ALSCON to sign sales, purchase agreement in February, accessed January 3, 2001, at URL http://www.ngrguardiannews.com/energy/eg808303.html). Reynolds International (a subsidiary of Reynolds Metals Co. until the May 2000 acquisition of Reynolds Metals and its subsidiaries by Alcoa Inc. of the United States) transferred its 10% interest in ALSCON to Ferrostaal (Nigeria) Ltd. after negotiations with the Government for the privatization of ALSCON failed (Delegation of German Industry and Commerce for West Africa, November 20, 2000, Privatisation of ALSCON stalled, accessed October 31, 2001, via URL http://www.ahk-lagos-ng.de). Ferrostaal was to manage the ALSCON plant when operations restart.

VAI Industries Ltd. of the United Kingdom began a 6,000-t/yr rolling-mill capacity-expansion project for First Aluminium plc of Nigeria. First Aluminium announced the renovation would expand its rolling capacity to 12,000 t/yr (Metal Bulletin, 2000d).

Steel.—Like many Nigerian industries, the production operations of the primarily Government-owned steel sector had been severely restrained by the lack of funding and associated transportation problems (Seun Adeoye, May 15, 2000, Why steel sector is distressed, by Ige, accessed May 15, 2000, at URL http://www.ngrguardiannews.com/news2/nm785512.html). In 1999, work resumed on a rail line to connect Nigerian Iron Ore Mining Co.'s Itakpe Mine with the steel plant at Ajaokuta and port facilities at Warri (Metal Bulletin, 1999). Construction of the rail link has been intermittent since 1979.

Various proposals for the completion of the Ajaokuta Steel Co. Ltd. plant; the reopening of Delta Steel Co. Ltd.'s plant at Aladja; the restart of the mills of Jos Steel Rolling Co. Ltd., Katsina Steel Rolling Co. Ltd., and Oshogbo Steel Co. Ltd.; and the resumption of mining at the Itakpe Mine were announced (Metal Bulletin, 1999, 2000c, f). Rolling resumed at a reduced rate at the Katsina mill for a few weeks in April (Metal Bulletin, 2000f, h). In November, the Nigerian Privatisation Agency announced that 40% equity interest in the Jos, the Katsina, and the Oshogbo mills would be offered for sale in 2001 (Metal Bulletin, 2000a). The Government allocated $2 million to each of the mills at Jos, Katsina, and Oshogbo for rehabilitation and to import steel billets to process (Metal Bulletin, 2000e).

Wiedemann & Walters GmbH of Germany reportedly was renovating the light section and the wire rod mill at Ajaokuta (Alifa Daniel, Guardian, January 4, 2001, Austrian firm to refurbish foreign Delta Steel, accessed January 4, 2001, at URL http://www.ngrguardiannews.com/news2/nn808406.html). In December, Vsesojuznoje Importno-Exportnoje Objedieneije Tyazhpromexport of Russia completed a technical audit of the Ajaokuta steel plant. Tyazhpromexport, which had been the general contractor for the Ajaokuta complex from 1979 until construction ceased in 1994, estimated that the completion of construction and repairs necessary to allow the plant to begin liquid steel production would cost an additional $600 million (Metal Bulletin, 2000c; Gabriel Agbonika, August 22, 2000, Towards reactivating Ajaokuta Steel Company, accessed August 23, 2000, via URL http://www.postexpresswired.com).

Tantalum and Tin.—Demand for tantalite surged as the year ended. During the late 1990s, the price had hovered about $14 per kilogram (Cunningham, 2001). During 2000, because of increased demand by the manufactures of consumer electronics, the price of tantalite rose to $70 per kilogram in September, and reached $165 per kilogram by yearend (Metal Bulletin, 2000l; 2001b). In Nigeria, large tantalite and tin concessions were held by State-owned companies; tantalite mining, however, was dominated by small-scale mining operations. Bakuwa Mining Works Ltd. appeared to be the largest legal local producing company. International companies active in tantalite exploration or promotion included Alluvial Dredging & Mining Services N.V. of the Netherlands, CME Managing Consultants Inc. of Canada, Columbia River Resources Ltd. of Canada, and West African Venture Exchange Corp. of Canada.

The Government-owed Nigerian Mining Corp. (NMC) sought investors to finance the development of its tantalite concessions. Consolidated Tin Mines Ltd. (an NMC subsidiary) awaited funding to pay salary arrears and to resume tin mining. Private tin minismelters filled in for the closed Makeri tin smelter (Metal Bulletin, 2001a).

Industrial Minerals

Cement.—Disputes marred the privatization process, but by yearend, the Government had successfully divested its interest in four cement companies. Blue Circle Industries Ltd. of the United Kingdom increased its equity ownership of West African Portland Cement Co. (WAPCO) with the December 1999 acquisition of 12% of the WAPCO shares from the Government. WAPCO was building a $130 million 1-million-metric-ton-per-year (Mt/yr)-capacity cement plant in Ewekoro to augment the combined 1.6-Mt/yr capacity of its old plants at Ewekoro and Sagamu (Ade Ogidan, October 11, 2000, WAPCO to boost operational profile with new plant, accessed October 11, 2000, at URL http://www.ngrguardiannews.com/business2/bn799808.html). In January 2000, Unión Marítima International S.A. of Spain acquired 40% of the shares of Eastern Bulkcem Co., which operated a bulk cement terminal in Port Harcourt. In March, Blue Circle bought 26% of the shares of Asahaka Cement Co. plc from the Government after which Blue Circle controlled 51% of the shares of Asahaka. Dangote Industries Ltd. of Nigeria secured the controlling shares of Benue Cement Co. plc (BCC) that were made available when the Government privatized its 35% interest in the company. Fire damage subsequently closed BCC for 3 months. The plant reopened in December. In July, Scancem International ANS of Norway acquired the Government's 40% interest in the Cement Company of Northern Nigeria.

Nitrogen.—National Fertilizer Co. (NAFCON) had ceased production at its plant in Onne, Rivers State, in 1999. NAFCON announced that Kellogg Brown & Root, Inc. would rehabilitate the plant (Godwin Egba, October 17, 2000, NAFCON to begin production next year, accessed October 24, 2000, via URL http://www.postexpresswired.com).

Mineral Fuels

Bitumen.—Fast track development of the bitumen deposits in southwestern Nigeria stalled. In July 1999, the Government received about 22 bids on the 15 bitumen exploration and development blocks offered, but leases were not assigned nor were licenses issued. In early 2000, the Government began an environmental impact assessment of the proposed bitumen project area and continued its review of applicable regulations begun after the 1999 lease sale. In October, the Ministry of Solid Minerals Development announced that a new State-owned company would be formed to oversee bitumen exploration and development (Alifa Daniel, October 12, 2000, Govt to form agency for bitumen project, accessed October 12, 2000, at URL http://www.ngrguardiannews.com/news2/nn799922.html). In December, the Government proposed a year-long seismic survey of project area, which would prohibit lease assignment until 2002 at the earliest.

Coal.—Nigerian Coal Corp. began limited production of smokeless coal briquettes that linked Government programs to increase coal production and to reduce household dependence on firewood, kerosene, and liquid petroleum gases. Product distribution was reported in Abuja and Enugu (Alifa Daniel, October 15, 2000, Coal briquettes flood Abuja, accessed October 15, 2000, at URL http://www.ngrguardiannews.com/news2/nn800312.html).

Natural Gas and Petroleum.—Nigeria Liquified Natural Gas Ltd. began production from Train One in February at its plant at Finima on Bonny Island. Train Two had gone online in September 1999. Petroleum prospects on which significant discovery or appraisal wells were drilled during 1999 and 2000 included the Ehra prospect in 1,180 meters (m) of water on Oil Prospecting Lease (OPL) 209; the Agbani prospect, about 360 kilometers southwest of Lagos in 1,460 m of water, straddled OPL 216 and 217; the Ikija prospect on OPL 216; the Ekoli prospect on OPL 217; and the Akpo prospect on OPL 246. Shell Nigeria Exploration and Production Co. Ltd. and a local subsidiary of Exxon Mobil Corp. were partners on Block 209. Joint-venture partners on OPL 216 included Famfa Oil Ltd., Nigerian National Petroleum Corp., Petroleo Brasileiro Nigeria Ltd., and Star Deep Water Petroleum Ltd. Partners on Block 217 included Nigerian National Petroleum Corp., Statoil A/S, and Texaco Nigeria Outer Shelf Ltd. TotalFinaElf Group operated OPL 246 for partners South Atlantic Petroleum Ltd. and Petroleo Brasileiro S.A. Nigeria. Onshore, Shell Petroleum Development Co. Ltd. discovered oil on the Soku North prospect in Rivers State.

For general background coverage of the oil and gas sector in Nigeria, see the U.S. Energy Information Administration's April 2001 Nigeria country analysis brief at URL http://www.eia.doe.gov/emeu/cabs/nigeria.html.

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Major Sources of Information

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TABLE 1
NIGERIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998 e/	1999 e/	2000 e/
METALS						
Aluminum		--	2,500 e/	20,000	16,000	--
Columbium and tantalum concentrates: e/						
Gross weight		57 4/	60 4/	70	70	80
Nb content		23	23	30	30	35
Gold e/	kilograms	6	6	10	10	10
Iron and steel: e/						
Iron ore, gross weight	thousand tons	100	50	--	--	--
Steel, crude	do.	--	--	2	--	--
Lead, metal, refined e/	do.	4	4	5	5	5
Tin:						
Mine output, cassiterite concentrate:						
Gross weight		139	150	200	200	300
Sn content e/		100	100	130	130	200
Metal, smelter		100	100	150	50	50
INDUSTRIAL MINERALS						
Barite 5/		--	4,000 e/	5,000 4/	5,000	5,000
Cement, hydraulic	thousand tons	2,545	2,520 e/	2,700	2,500	2,500
Clays:						
Kaolin		102,078	100,000	110,000	110,000	110,000
Unspecified e/		100,000	100,000	100,000	100,000	100,000
Feldspar		800	1,000	500	500	600
Gypsum		383,250	300,000 e/	300,000	200,000	30,000
Nitrogen: e/						
N content of ammonia	thousand tons	164	134	167	148 r/	--
N content of urea	do.	114	41	105	100	--
Stone:						
Limestone	do.	2,095	2,000 e/	2,000	2,000	2,000
Marble	do.	29	30	30	30	30
Shale e/	do.	500	500	500	500	500
Topaz e/	kilograms	1,500	1,000 r/	1,700	2,500 r/	2,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous		7,116	7,000	30,000	30,000	35,000
Gas, natural: e/						
Gross	million cubic meters	37,000	30,000	30,000	30,000	30,000
Dry	do.	6,000	5,400	6,000	7,000	13,000
Petroleum:						
Crude	thousand 42-gallon barrels	798,620	845,000	788,000	777,000	783,000
Refinery products:						
Gasoline	do.	23,000 e/	47,800	18,300 r/	10,000	25,000
Jet fuel e/	do.	300	3,650	2,200 r/	1,000	2,000
Kerosene	do.	10,000 e/	21,200	6,200 r/	6,000	10,000
Distillate fuel oil	do.	20,000 e/	22,300	18,300 r/	9,000	20,000
Residual fuel oil	do.	18,000 e/	28,100	11,700 r/	12,000	18,000
Unspecified	do.	8,000 e/	15,300	17,500 r/	5,000	15,000
Total	do.	79,300 e/	138,000	74,200 r/	43,000	90,000

e/ Estimated. r/ Revised. -- Zero.

1/ Includes data available through October 10, 2001.

2/ Estimated data were rounded to no more than three significant digits; may not add to totals shown.

3/ In addition to the commodities listed, amethyst, aquamarine, bitumen, diamond, emerald, garnet, granite, lead, phosphate rock, sapphire, soda ash, talc, tourmaline, tungsten, zinc, and zircon are mined, and a variety of crude construction materials (stone, sand and gravel) are produced, but infomation is inadequate to estimate output.

4/ Reported figure.

5/ Considerably more barite is produced, but is considered to be commercially unusable.

THE MINERAL INDUSTRY OF

SOUTH AFRICA

By George J. Coakley

The Republic of South Africa holds a major economic and physical presence on the African continent. In 2000, it ranked second after Libya in per capita gross domestic product (GDP) based on purchasing power parity data for 2000 at $8,500[1] per capita and fifth in population and land area with 43.6 million people and 1,219,912 square kilometers, respectively; by comparison, the land area of South Africa is slightly more than twice the size of Texas. The GDP grew at a rate of 3.1% in 2000; this was its highest growth in 3 years. Of total exports of all goods, which were valued at $30.8 billion, mineral commodities accounted for about 47%. The minerals industry contributed about 25% to 31% of the GDP, of which 6.5% came from primary mined products and 20% to 25% from value-added processed mineral products, such as aluminum, ferroalloys, and steel. The rand (R), which continued its steady decline relative to the U.S. dollar, reached R7.5 to $1.00 by yearend 2000 compared with R3.55 to $1.00 in 1994. The weakness of the rand, however, allowed the mineral sector to remain competitive internationally by helping balance internal rand costs with revenues from dollar-denominated mineral exports; this also contributed to South Africa maintaining a net positive trade balance of $3.2 billion in 2000 (U.S. Central Intelligence Agency, 2001, South Africa, World Factbook 2001, accessed October 10, 2001, via URL http://www.odci.gov/cia/publications/factbook/index.html; U.S. Department of State, 2001, South Africa, Country Commercial Guide, accessed October 10, 2001, via URL http://www.usatrade.gov/Website/CCG.nsf).

Mining has been the mainstay of the economy for more than 100 years and has contributed significantly to the industrial development of the country. In the past 10 years, the development of export-oriented value-added processing aluminum, ferroalloys, steel, and titanium industries has become an important component of the mineral economy of South Africa, and has generated more than $3 billion per year in export earnings. The development of these value-added industries along with an expansion in coal exports and a recent sharp increase in platinum-group metal (PGM) prices have helped compensate for the declining role of gold in the economy. Owing to the high cost of deep gold mining in South Africa and the decline in world market price for gold, gold export earnings have dropped sharply by from $300 million per year to $900 million per year since 1994. In 2000, gold exports were only $3.4 billion compared with slightly more than $7 billion in 1994. In 2000, for the first time ever, the value of PGM exports ($3.8 billion) exceeded that of gold exports. The mining and minerals processing through semimanufactured products accounted for more than 500,000 jobs. Employment in the primary mining sector, however, declined to 437,000 in 1999 from 466,700 in 1998 and from more than 778,000 in 1990 (South Africa Department of Minerals and Energy, 2001, p. 9).

The most important mineral commodities produced in South Africa, in terms of value, were PGMs, gold, coal, ferroalloys (ferrochromium, ferromanganese, ferrosilicon, and ferrovanadium), aluminum, steel, titanium, iron ore, diamond, vanadium, and copper. Additionally, important output of metallic commodities included antimony, chromite, cobalt, lead, manganese, nickel, silver, uranium, zinc, and zirconium. Significant industrial minerals production included andalusite (aluminum silicate), aggregate and sand, asbestos, dimension stone, fluorspar, limestone and lime, phosphate rock, sulfur, and vermiculite. South Africa was a major producer and the world's third largest exporter of coal and the largest producer of synthetic liquid fuels and petrochemicals derived from coal. South Africa's well-developed railway and port infrastructure served the domestic minerals industry and those in neighboring countries. In 1999, South Africa produced more than 62 mineral commodities from about 695 mines and quarries, which included about 61 coal mines, and 54 diamond and 53 gold operations.

Government Policies and Programs

The Ministry of Mines and Energy's Department of Minerals and Energy (DME) is the primary Government entity responsible for the establishment and implementation of minerals and energy policy and for oversight of the country's mineral industry. Within the DME are the Mineral Development Branch, which is responsible for regional mineral development, minerals economics (Minerals Bureau), mine rehabilitation, and mining rights; the Energy Branch, which promotes the optimum utilization of energy resources; and the Mine, Health & Safety Inspectorate. A number of parastatal institutions that are associated with the DME include Atomic Energy Corp., the Council for Nuclear Safety, the Council for Geosciences (formerly the Geological Survey of South Africa), the parastatal mineral-research organization Council for Mineral Technology (Mintek); the National Electricity Regulator; the South African Diamond Board; and Central Energy Fund (CEF) (Pty.) Ltd., through which the state's interest in the liquid fuel industry is owned, developed, and managed commercially.

Following 5 years of public and internal Government debate, the DME published its draft Minerals Development Bill, 2000, in the Government Gazette of December 18, 2000. The draft bill was open to public comment until March 31, 2001. This bill will give the state exclusive custodianship of all mineral rights and focused on the freeing up of unexploited mineral rights long held by the major mining houses to provide more opportunities in the mining sector for black South African entrepreneurial groups and for foreign investment.

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[1] Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R6.94=US$1.00 for 2000 and R6.11=US$1.00 for 1999.

The introduction to the bill states, "The fundamental principles which underpins this bill are

"a. mineral resources is the common heritage of all South Africans and belongs collectively to all the peoples of South Africa;

"b. it is a universally recognized right of a state to exercise full and permanent sovereignty over all its natural resources;

"c. public trusteeship of South Africa's mineral resources;

"d. to redress the results of past racial discrimination and ensure the historically disadvantaged persons participate in the minerals and mining industry and benefit from the exploitation of the nation's mineral resources; security of tenure for prospecting and mining operations;

"e. environmental protection and sustainable development; and

"f. promotion of local and rural economic development and social upliftment of communities affected by mining.

"The minerals and mining law dispensation proposed in the draft bill is based on the universally accepted principle that mineral resources are part of South Africa's national patrimony and that the State is the custodian of the nation's mineral resources. It is from the aforementioned principles that the state derives its entitlements to control, administer, manage access to South Africa's mineral resources, to grant prospecting rights and mining rights and issue retention permits.

"Therefore, on commencement of the new legislation, prospecting rights, mining rights, retention permits and permission to remove minerals will only be granted by the state. As far as possible the bill reduces ministerial discretion by ensuring that discretionary powers are exercised based on prescribed criteria" (Government of South Africa, December 18, 2000, Mineral development draft bill, Government Gazette, accessed October 1, 2001, at URL http://www.polity.org.za/govdocs/notices/2000/not4577.html).

In its initial reaction to the bill, the Chamber of Mines, which represents the largest sectors of the South African mining industry, supported the underlying objectives of the bill but expressed concern over its ability to achieve these objectives without "unintended negative consequences." The Chamber argued that the bill would undermine fundamental property rights, give excessive discretion to a single person (the Minister of Mines and Energy), offer no right of appeal to the courts, create legislative and regulatory uncertainty, make it more onerous to meet licence requirements, and introduce a royalty system that could put thousands of jobs at risk. The Chamber was concerned over the lack of clarity on compensation for expropriated properties and the impact proposed taxes could have on production costs and the international competitiveness of the industry (Zoli Diliza, February 28, 2001, Industry warns of unintended consequences of new draft mineral development bill, South Africa Chamber of Mines Media Release, accessed June 1, 2001, at URL http://www.bullion.org.za/bulza/release2001/bill.htm).

Subject to the enactment of the bill by Parliament, the South African mineral industry operates under the Mining Titles Registration Act, 1967; the Central Energy Fund Act, 1977; the Petroleum Products Act, 1977; the Diamonds Act, 1986; the Electricity Act, 1987; the Mineral Technology Act, 1989; the Minerals Act, 1991; the Minerals Amendment Act, 1993; the Nuclear Energy Act, 1993; the Liquid Fuels and Oil Repeal Act, 1993; the Mineral and Energy Laws Rationalization Act, 1994 (which repealed the Mining Rights Act of 1967); and the Mine Health and Safety Act, 1996. A 1998 ruling by the Minister of Finance set the corporate tax rate at 35% for all companies entering offshore oil and gas subleases with Soekor E and P (Pty.) Ltd. by the end of 1999.

In February 2000, a mining summit was held among government, labor, and industry leaders and invited nongovernmental and community organizations representatives. The objective of the summit was to seek a common vision for the mining industry and to reach consensus on ways to improve its job creation potential as well as to stabilize employment and develop skills. As an outcome of the meeting, a Sector Partnership Committee was established to develop policy recommendations for several areas, which included mineral promotion, development, and managing cyclical volatility; coordinated and integrated rural development; and employment and human resources development. The Sector Partnership Committee replaces the Gold Crisis Committee, which had been established in 1998; it was modeled after a new advisory board proposed in the bill (South Africa Chamber of Mines, February 2000, Mining industry agreements, accessed June 1, 2001, at URL http://www.bullion.org.za/bulza/agreements/Mining%20Summit.htm).

Environmental Issues

Following the consultative national environmental policy process, which was an initiative by the Department of Environmental Affairs and Tourism (DEAT) to review the state of the environment in South Africa, DEAT released its draft white paper on environmental management policy for South Africa in May 1997 (Department of Environmental Affairs and Tourism, July 1997, White paper on environmental management policy, accessed December 12, 1998, at URL http://www.polity.org.za/govdocs/white_papers/envir.html). The white paper confirmed the Constitutional right to a healthy environment and established a policy of sustainable development as the accepted approach to resource management and utilization in South Africa.

The National Environmental Management Act (107 of 1998) (NEMA) created a framework for environmental management in South Africa. It established principles for sustainable development, procedures for coordinating the environmental functions of government, and mechanisms for civil society participation. The NEMA, however, did not deal with the details of coastal management, biodiversity conservation, and integrated pollution and waste management. During 2000, the DEAT began work on a Law Reform Program to amend sections of the NEMA to give effect to the white papers on biodiversity, sustainable coastal development, and integrated pollution and waste management. This legislation will be written as new chapters within the NEMA; the first drafts of the legislation have been scheduled for public comment in 2002.

The NEMA required departments that have an impact on the environment or that have an environmental management function to prepare environmental management plans (EMPs), environmental implementation plans (EIPs), or both. These plans are submitted to the interdepartmental Committee for Environmental Coordination (CEC) for approval and adoption. During the year under review, the CEC accepted the EIPs and the EMPs from the DME (South Africa Department of Environmental Affairs and Tourism, [2001], Environmental planning and coordination—A connected world, Annual Review 2000-01, accessed October 1, 2001, at URL http://www.environment.gov.za/Documents/Publications/AnnualReport2000-01/EnvPlanCoord.htm; South Africa Department of Minerals and Energy, February 23, 2001, Minerals and energy—Environmental management plans, Government Gazette, accessed October 1, 2001, at URL http://www.dme.gov.za/publications/policydocuments.htm).

Production

In 2000, South Africa was one of the largest and most diverse minerals producers in the world. As shown in table 1, output levels of more than 60 mineral commodities were mixed. Of the major metal commodities, production increases were significant (14% to 37%) for cobalt, direct reduced iron, iron ore, ferrochromium, manganese, and zirconium and modest (1% to 7%) for ferromanganese, nickel, steel, titanium, and zinc. Production declines of 2% to 6% were noted for aluminum, chromite, copper, gold, lead, PGMs, and silver. In the industrial minerals sector, production of asbestos and diamond increased, and that of fluorite, gypsum, granite, phosphate rock, and salt declined. With the startup of the new Oryx oilfield offshore Mossel Bay in May 2000, oil production increased by 20% to more than 6 million barrels per year.

On a value basis, about 23% of primary mined products and 18% of processed mineral materials were consumed domestically in 1999. More than 70% of coal production went for internal power generation and for value-added synthetic fuel and petrochemicals production. Using South Africa's natural comparative advantage in its mineral resource endowment of chromite, iron ore, manganese, and nickel, these materials were also converted to value-added ferroalloy and steel products for world markets.

Trade

In 2000, the total value of sales of primary minerals, as reported by the DME Minerals Economics Directorate (Minerals Bureau), was $14.2 billion, of which $11 billion was exported, compared with $12.3 billion and $9.5 billion, respectively, in 1999. For 1999, the total value of all processed mineral materials was $2.98 billion, of which $2.43 billion was exported. The major exports by value in 1999 were gold at $4.09 billion; coal, $2.84 billion; PGMs, $2.43 billion; ferroalloys, $980 million; aluminum, $687 million; iron ore, $282 million; vanadium, $146 million; and copper, $118 million. Other significant exports, for which individual value data were not provided included diamond, steel, titanium, and zirconium (South Africa Department of Minerals and Energy, 2001).

Listed in declining value order, the majority of primary mineral exports, which included precious minerals, went to European markets followed by the Pacific Rim countries, the Middle East and the Near East, and North America and Central America with less than 10% each. Exports within Africa accounted for less than 1% of the South African mineral export trade.

Although South Africa was self-sufficient in the vast majority of its mineral needs, some mineral commodities were imported. Significant mineral imports included alumina, coking coal, rough and cut diamonds, certain ferroalloys, magnesite, magnesia, nickel, precious metals, and sulfur. Imports of primary and processed mineral products in 1999 totaled $1.5 billion with an additional $2.09 billion in crude petroleum imports reported (South Africa Department of Minerals and Energy, 2001, p. 13-16).

Structure of the Mineral Industry

The South African minerals and energy industries operated on a free-enterprise, market-driven basis. Ownership of mineral rights was held by either the Government or private entities. Mineral rights would revert to the state under terms of the draft Minerals Development Bill, 2000. Government involvement in these sectors was minimal and primarily confined to ownership of the national electric power utility Eskom and the national oil and gas exploration company Southern Oil Exploration Co. (Soekor). The Government also provided additional declining subsidies to the synthetic fuels programs of two parastatals, Mossgas (Pty.) Ltd. and Sasol Limited. Sasol received a subsidy when the derived price of oil, a figure calculated by the Government on a monthly basis, falls below $16 per barrel.

In South Africa, the bulk of mineral land holdings and production has historically been controlled by five mining investment houses. Since 1994, however, the industry has undergone a major corporate restructuring, or "unbundling," aimed at simplifying a complex system of interlocking ownership that existed in the past, establishing separate core-commodity-focused profit centers, and diversifying and rationalizing nonperforming assets to make the newly restructured companies more competitive internationally. The structure and ownership of the industry as of mid-2001 is shown in table 2.

This period also saw the movement of two major corporate financial headquarters, Anglo American plc and Billiton plc (incorporating the former Gencor Limited), from Johannesburg to London, United Kingdom. Concerned with this trend "in capital flight," the Government blocked the $3 billion merger of Gold Fields Ltd. with Franco-Nevada Mining Corp. of Canada in September 2000 (Allan Robinson, September 22, 2000, South Africa rejects Franco-Nevada deal, accessed October 1, 2001, at URL http://www.globetechnology.com/archive/20000922/RGOLD.html). In mid-2001, however, the Government subsequently approved the $19 billion takeover of De Beers Consolidated Mines Ltd. (De Beers) by Anglo American (Business Day, May 29, 2001, High Court sanctions buyout of De Beers, Business Day [Johannesburg], accessed October 1, 2001, at URL http://www.bday.co.za/bday/content/direct/1,3523,858608-6078-0,00.html).

The Chamber of Mines, whose members represent the majority of coal, gold, and uranium producers, was responsible for a variety of advisory and service functions for mining interests in South Africa. One of its main activities was the annual wage negotiations between member mines and the

National Union of Mineworkers.

Commodity Review

Metals

Aluminum.—Because South Africa has no economically exploitable deposits of bauxite and no alumina production capacity, all alumina feedstock for the production of aluminum metal is imported. Billiton Aluminium South Africa (Pty.) Ltd. was the sole producer of primary aluminum from its Bayside smelter and the newer Hillside smelter at Richards Bay. Effective as of the June 2001 merger of Billiton plc and BHP Ltd. of Australia, the plant will be owned by the new company BHP Billiton Plc. For the fiscal year ending June 30, 2001, the Hillside smelter produced 498,000 metric tons (t) of aluminum metal, and the Bayside smelter, 178,000 t. At Hillside, BHP Billiton was conducting a feasibility study directed at expanding Hillside smelting capacity by another 130,000 metric tons per year (t/yr). An upgrade of the casting house at the Bayside smelter will permit BHP Billiton to produce more value-added products, which will include extrusion ingots, rolling ingots, rods, and rim alloys (BHP Billiton plc., 2001, p. 22-23).

Antimony.—Metorex Ltd. (a subsidiary of Crew Development Corp. of Canada), which operated the Consolidated Murchison mine near Gravelotte in the Northern Province, was South Africa's only producer of antimony (as stibnite concentrate); its output of about 8% of world production made South Africa the second largest producer after China. The mine hoists ore from three shafts—the Athens, the Beta, and the Monarch shafts. Production from the reequipped Beta Shaft resumed in the first quarter of 2001. For the fiscal year ending June 30, 2001, Consolidated Murchison treated 40,000 metric tons per month (t/mo) that averaged 1.10% antimony and 2.2 grams per metric ton (g/t) gold. Recovery rates were 81.47% for antimony and 96.79% for gold. Production was 7,067 t of stibnite concentrates that contained an average of 58% antimony and 1,089 kilograms (kg) of gold. Since large-scale mining began in 1937, the Consolidated Murchison Mine has produced 53,000 t of antimony contained in concentrates and 25.25 t of gold. On June 30, 2001, proved and probable reserves amounted to 1.5 million metric tons (Mt) at 2.2% antimony and 2.8 g/t gold, inclusive of 15% dilution and a mine call factor of 85%. Mineral resources exclusive of reserves total 8.6 Mt at grades of 2.5% antimony and 2.6 g/t of gold (Metorex Ltd., 2001, Our companies—Our operations—Consolidated Murchison Mine, accessed October 18, 2001, at URL http://www.metorexgroup.com).

Chromite and Ferrochromium.—Chromite ore production decreased by 3% in 2000 to 6.62 Mt. South Africa was the global leader in chromite ore production and export. Production came from more than 20 mines located within the Bushveld Ultramafic Complex. About 84% of the ore went to supply domestic ferrochrome smelters, and the remainder was exported. Domestic consumption of chromite ore, which was the highest in the world, fed the world's leading ferrochrome industry as well as a major chromium chemicals and refractories industry. Chromite ore sales were valued at about \$155 million in 2000, of which about \$52 million was export revenue.

For the fiscal year ending June 30, 2001, BHP Billiton's Samancor Group, which was the world's largest integrated ferroalloys producer, produced 3.16 Mt of chromite ore and 908,000 t of chrome alloys. Samancor's operations were organized under two mining centers—Eastern Chrome Mines, which is based at Steelpoort, and Western Chrome Mines, with its mine office at Mooinooi near Rustenburg. The total combined ore reserved exceed 450 Mt, calculated to a depth of 300 meters (m) with production capacity of more than 4 million metric tons per year (Mt/yr). Samancor's total chromite resources exceed 1.8 billion metric tons (Gt) and were expected to support mining activity for more than 200 years at the current (2000) extraction level (BHP Billiton plc., 2001, p. 24; Samancor Group, 2001, Samancor—Chrome—Production process, accessed October 18, 2001, at URL http://www.samancor.co.za).

Xstrata AG of Switzerland produced 1.14 Mt of ferrochrome in calendar year 2000; this was a 15% increase compared with that of 1999 from its three smelting operations at Lydenburg, Rustenburg, and Wonderkop. Production of salable chrome ore for the year amounted to 1.9 Mt. The Thorncliffe Mine contributed 855,000 t and met the ore requirements of the Lydenburg smelting operations, which produced nearly 450,000 t of ferrochrome in 2000. Xstrata mines supplied more than 60% of the ore feed required by the its ferrochrome smelters. The balance was purchased from third parties, a major portion of which was obtained from platinum mines in the form of chrome-bearing tailings. Xstrata reported that the use of these tailings, when combined with the its agglomeration technology, continued to provide an extremely competitive source of chrome feed for the production of ferrochrome. The \$28 million development of the Waterval West section of the Townlands chromite ore deposit was delayed by abnormal rains and unforeseen technical difficulties. The surface plant will be commissioned early in 2001, and underground development will be completed by yearend 2001 and will be sufficient to produce 780,000 t/yr of run-of-mine chromite ore.

In June 2000, the company entered into a production joint venture with Samancor to gain access to large quality chrome ore deposits adjacent to its existing Kroondal Mine in the Rustenburg area. The Kroondal Mine infrastructure was being expanded to produce more than 1.2 Mt/yr of run-of-mine production to yield 840,000 t/yr of salable chromite ore. The ore will be available for use by both the joint venture and at Xstrata's Wonderkop ferrochrome furnace. The Samancor and Xstrata joint venture was also building two new furnaces at Wonderkop with a combined capacity of 180,000 t/yr of ferrochrome. Commissioning was scheduled for mid-2001. The new furnaces at Wonderkop will replace the capacity of the two furnaces in Rustenburg that were shut down in the fourth quarter of 2000 for upgrading and to control inventory levels. As of yearend 2000, Xstrata reported proven chromite reserves of 4.4 Mt at a grade of 40.1% Cr_2O_3 and a chrome-to- iron ratio of 1.49; probable reserves of 21.8 Mt at a grade of 39.7% Cr_2O_3 and a chrome to iron ratio of 1.45; and combined measured, indicated, and inferred resources of 332.9 Mt at grades that range from 36.3% to 40.9% Cr_2O_3 and chrome-to-iron ratios of from 1.33 to 1.53 (Xtrata AG, 2001, Annual report for 2000—Review of operations—Metals & minerals—Chrome business unit, accessed October 18, 2001, at URL http://www.xstrata.com/reports/2000-en/metals.php).

In October 2000, Associated Manganese Mines of South Africa Ltd. [a subsidiary of Anglovaal Mining Ltd. (Avmin)] commissioned its new $30 million Dwarsrivier open pit chrome mine and beneficiation plant located approximately 30 kilometers (km) from Steelpoort and 60 km from Lydenburg. The Dwarsrivier operation will deliver chrome ore to Assmang's chrome alloy smelter in Machadodorp about 150 km from the mine. With the startup of the underground section in late 2001, the mine will produce 1 Mt/yr of run-of-mine chromite ore. This mine is part of a $173 million capital investment program being undertaken by Assmang Group during the next 3 years. Assmang's ferrochrome capacity was expected to double by the end of 2001 with ore being sourced from the Dwarsrivier chrome-mining complex and with the commissioning of the new 54 megavoltoampere furnace and pelletizing plant at Machadadorp Works (Anglovaal Mining Ltd., 2001, Operations—Dwarsrivier—Chrome, accessed October 20, 2001, at URL http://www.avmin.co.za/operations/dwarsrivier.asp).

Copper.—Palabora Mining Company Limited (owned by Rio Tinto plc) operated the largest integrated copper complex in South Africa. Production declined by 5% in 2000 because of operating problems with the converter at the copper smelter and as the company began to transition from 80,000-metric-ton-per-day (t/d) open pit mining to 30,000-t/d underground mining, which was scheduled for startup in November 2002. The $380 million underground development project will extend the life of the mine for another 20 years. During 2000, Palabora treated 25.7 Mt of ore at a grade of 0.58% copper that yielded 388,151 t of copper concentrates that contained 127,548 t of copper. The copper concentrate grade was 32.6%. The Palabora smelter produced 90,727 t of copper anodes, which was down by 11% from 1999; the refinery output declined to 87,683 t of copper cathodes from 100,044 t in 1999. Palabora also produced a variety of other products from the unique carbonatite mineralogy of its deposit; these included 8,526 t of baddeleyite (approximately 70% of world demand), 263 t of nickel sulfate, 139,491 t of sulfuric acid, 86,299 kg of uranium oxide, 208,422 t of 90.65% vermiculite concentrates, and 7,897 t of zirconium dioxide chemicals, as well as 7,804 kg of precious metals contained in refinery tankhouse slimes. The Palabora Mine also generated 240,000 t of byproduct magnetite concentrates at a grade of around 62% iron and 1.6% titanium dioxide, which were either sold to the coal-washing industry or stockpiled for possible future use in a proposed new hot briquetted iron facility in Mozambique (Palabora Mining Company Limited, 2001, p. 48).

O'okiep Copper Co. (Pty.) Ltd. (owned by Metorex Ltd.) operated a copper mine at Nigramoep and a copper smelter at Nababeep in the Northern Cape Province. For the fiscal year ending June 30, 2001, O'okiep milled 67,000 t/mo of ore at an average head grade of 1.78% copper. With a 95% smelter recovery rate, blister copper production was 13,000 t/yr. Remaining proved mineral reserves were reported to be 4.9 Mt at a grade of 1.6% copper. Mineral resources exclusive of reserves amounted to 7.0 Mt at a grade of 1.1%. Although a decision was made to begin closing down mining operations in 2002, Metorex was investing more than $7 million to build a new concentrator at Nababeep to retreat the slag dump, which was estimated to have a grade of 1.5% copper. This project should be completed early in 2002 and was expected to run for 7 years (Metorex Ltd., 2001, Our companies—Our operations—O'okiep Copper Co. (Pty.) Ltd., accessed October 18, 2001, at URL http://www.metorexgroup.com).

Copper was also produced in small amounts as a byproduct of lead-zinc and platinum mining.

Gold.—In 2000, mine production was nearly 431 t of gold compared with 451 t of gold in 1999 and 989 t of gold during of the historic peak production year of 1970. Gold ore grades steadily declined to 4.5 g/t in 2000 from more than 13.3 g/t in 1970. During this same period, employment in the gold mines declined to 197,500 from 416,800. South Africa remained the world's leading gold producer, although its once-dominant share of total global new mined gold production dropped to about 17% in 1998 from 68% in 1970. The depreciation of the rand has permitted South African gold mines to remain competitive internationally with the industry committing more than $360 million in new capital expenditures in 2000; this was a 4% increase compared with that of 1999 (Chamber of Mines of South Africa, 2000, South Africa mining industry—Statistical tables—2000—Gold industry data, accessed October 20, 2000, at URL http://www.bullion.org.za/bulza/publications/Stats2000/StatsTables.pdf).

Gold production in 2000 was dominated by Anglogold Ltd. (the gold division of Anglo American), which accounted for 37% of mine production; Gold Fields Ltd., 25.7%; Harmony Gold Mining Co., 15.3%; and Durban Roodeport Deeps Ltd., 7.9%.

During 2000, Anglogold's corporate focus was on new gold mine investments in Australia, Mali, and Tanzania. In South Africa, its strategic concentration was on higher profit margin, longer life operations. In line with this strategy, in December, Anglogold reached an agreement in principle to sell the Deelkraal and the Elandsrand Mines to Harmony for $132 million. Anglogold had three main operational centers in South Africa—the Free State Operations included four underground mines and the Free State surface mines, the Vaal Reefs operations ran four underground mines and a surface mine, and the West Wits Operation included five underground mines and the Western Ultra Deeps Mine. In 2000, production declined to 168,519 kg of gold from 178,690 kg in 1999. Anglogold reported South Africa ore reserves to be 364.1 Mt at a grade of 5.41 g/t gold in addition to measured and indicated resources of 1,558.9 Mt at a grade of 4.0 g/t gold (Anglo American plc, 2001, Reserves and resources, Annual Report 2000, accessed October 24, 2001, at URL http://www.angloamerican.co.uk/report2000/Report/ReservesResources.html). Development work on the Moab Khotsang Mine continued during 2000 with completion of the main shaft, which was sunk to 2,400 m; the subvertical shaft had been sunk and equipped temporarily down to 3,310 m. Development of the mine will continue for several years. Total capital costs will be between $700 million and $800 million. The high-grade Moab Khotsang deposit contained reserves of 18.5 Mt at a grade of 16.36 g/t gold and resources estimated to be 14.3 Mt at a grade of 26.52 g/t gold for a combined gold content of 681,000 kg (21.9 million troy ounces). As more in-fill drilling of resource zones was finished, it seems apparent that the mine reserve grade should increase (Anglogold Ltd., 2001, South Africa—Moab Khotsong, Operational Review, accessed October 20, 2001, at URL http://www.anglogold.co.za/AboutAngloGold/FactSheets/MoabKhotsang.asp).

Gold Fields operated three gold mining divisions in South Africa—the Dreifontein, the Kloof, and the Free State, which included the Beatrix and St. Helena Mines and the new underground Target development. For the fiscal year ending June 30, 2001, production from Gold Fields' South African operations decreased by 8% to 98,903 kg of gold as the operations were affected by significant seismic activity during the year and were forced to close down high- cost mining areas. For fiscal year 2001, the Dreifontein Division treated 6.55 Mt of ore, which yielded 6.4 g/t gold, for a total output of 42,031 kg of gold compared with 43,497 kg of gold for the year ending June 30, 1999. The Kloof Division treated 3.93 Mt of ore, which yielded 9.6 g/t gold, for a total output of 37,283 kg of gold compared with 43,394 kg of gold in 1999. At the Free State Operations, the Beatrix and Oryx Mines treated 2.81 Mt of ore, which yielded 5.5 g/t gold, for a total output of 15,372 kg of gold compared with 15,268 kg of gold in 1999, and the St. Helena Mine treated 0.92 Mt of ore, which yielded 4.6 g/t gold, for a total output of 4,217 kg of gold compared with 5,475 kg of gold in 1999 (Gold Fields Ltd., 2001, Review of operations, Annual Report 2001, accessed October 20, 2001, at URL http://www.goldfields.co.za/annual_report/ar2001/rev_op/rev_op.htm). As of the end of fiscal year 2000-2001, Gold Fields estimated that on the basis of a gold price of $270 per troy ounce, measured and indicated mineral resources were 106 Mt at a grade of 17.3 g/t gold, and proved and probable ore reserves were 71.1 Mt at grade of 12.9 g/t gold at Kloof; resources were 140.2 Mt at a grade of 11.2 g/t gold, and reserves were 103.1 Mt at grade of 8.8 g/t gold at Dreifontein; resources were 53.4 Mt at a grade of 8.8 g/t gold, and reserves were 67.8 Mt at grade of 6.52 g/t gold at Free State (Beatrix); and resources were 4.7 Mt at a grade 15.5 g/t of gold, and reserves were 2 Mt at grade of 5.0 g/t gold at Free State (St. Helena) (Gold Fields Ltd., 2001, Resources and reserves, Annual Report 2001, accessed October 20, 2001, at URL http://www.goldfields.co.za/annual_report/ar2001/explr_busdev/def_f_explr_dev.htm).

Since it was spun off from Randgold Resources Ltd. in 1997, Harmony Gold Mining Co. Ltd. has been developing into a major gold mining company that operates and turns around small, high-cost marginal gold operations. Through an aggressive acquisitions policy begun in 1995, Harmony has increased its gold production to 77,759 kilograms per year (kg/yr) from 18,040 kg/yr and since 1996, it has increased its gold reserve base from nearly 249 t (8 million troy ounces) to more than 1,026 t (33 million troy ounces). The reserve base estimates were based on a gold price of $262 per troy ounce. In addition to a gold mine in Australia and one in Canada, Harmony had five operating divisions in South Africa—the Elandsrand Operations (as of April 2001), the Evander Operations, Freestate Operations, the Kalgold Operations, and the Randfontein Operations. For fiscal year 2001, Freestate treated 5.29 Mt of ore at a recovered gold grade of 4.04 g/t, which yielded 21,344 kg of gold; Evander treated 2.48 Mt of ore at a recovered gold grade of 5.74 g/t, which yielded 14,252 kg of gold; Randfontein treated 6.28 Mt of ore at a recovered gold grade of 3.58 g/t, which yielded 22,501 kg of gold; for the last quarter of fiscal year 2000-2001, Elandskraal treated 0.7 Mt of ore at a recovered gold grade of 5.41 g/t, which yielded 3,822 kg of gold; and the Kalgold open pit treated 0.96 Mt of ore at a recovered gold grade of 1.60 g/t, which yielded 1,535 kg of gold (Harmony Gold Mining Co. Ltd., 2001, A business approach to mining—Ore reserves statement, Annual Report for 2001, accessed October 22, 2001, at URL http://www.har.co.za/section2/frames.htm).

Harmony reported reserves as of June 30, 2001, based on a gold price of $262 per troy ounce and an exchange rate of R8.00=$1.00, as follows: Freestate contained measured, indicated, and inferred mineral resources of 570 Mt at a grade of 3.55 g/t, of which proved and probable ore reserves were 44.3 Mt at a grade 4.78 g/t gold; Evander's total resources were 217.4 Mt at a grade of 6.29 g/t gold, of which total reserves were 44 Mt at a grade of 6.05 g/t gold; Randfontein's total resources were 916.3 Mt at a grade of 2.82 g/t gold, of which total reserves were 30.7 Mt at a grade of 5.75 g/t gold; Elandskraal's total resources were 121.7 Mt at a grade of 6.18 g/t gold, of which total reserves were 44.5 Mt at a grade of 7.10 g/t gold; and Kalgold's total resources were 38 Mt at a grade of 1.54 g/t gold, of which total reserves were 7.2 Mt at a grade of 1.91 g/t gold (Harmony Gold Mining Co. Ltd., 2001, Review of operations, Annual Report for 2001, accessed October 22, 2001, at URL http://www.har.co.za/section2/page25.htm).

Avgold Ltd. (the gold operating subsidiary of Avmin) was a modest producer of gold from its Eastern Transvaal Consolidated (ETCons) operations, near Barberton, Mpumalanga Province. After the closure of the Loraine Mine, ETCons was restructured to produce around 3,100 kg/yr of gold from three mines. Avgold's principal activity was the $300 million development of the Target Mine. Target was being developed on a twin decline system by using the infrastructure of the neighboring Loraine gold mine. Construction of the metallurgical plant started during January 2001, and the full production rate of around 10,900 kg/yr of gold was planned from the first quarter 2002. Target has a mine life of at least 13 years with an expected production cost of below $150 per troy ounce (Avgold Ltd., 2000, Operations—Target, accessed October 20, 2001, at URL http://www.avgold.co.za/operations).

Avgold estimated its proven mineral reserves, as of June 30, 2000, to be 4.87 Mt at a grade of 11.47 g/t gold; probable mineral reserves, to be 8.47 Mt at a grade of 3.32 g/t; and total mineral resources, inclusive of reserves, to be 346.2 Mt, at a grade of 6.51 g/t, which contained 2,253 t (72.44 million troy ounces) of gold (Anglovaal Mining Limited, 2000, Mineral resources and reserves, Annual Report for 2000, accessed October 22, 2001, at URL http://www.avmin.co.za/investor/interim311200.pdf).

Avgold has completed a comprehensive exploration drilling program within its extensive Paradise lease areas north of the Target Mine. The indicated and inferred total resource of the Paradise area was estimated to contain 429 t (13.8 million troy ounces) of gold at an average grade of 10.02 g/t gold. A prefeasibility study was completed on the Paradise area by yearend 2000, to assess the viability of increasing the Target project's production level from 10,999 kg/yr of gold to 15,550 kg/yr of gold and to extend the mine life from 13 years to more than 40 years (Anglovaal Mining Limited, 2000, Interim report for the half year ended 31 December 2000—Review of operations, accessed October 22, 2001, at URL http://www.avmin.co.za/investor/interim311200.pdf).

In April 1999, Placer Dome Inc. of Canada purchased a 50% interest in Western Areas Limited South Deep gold mine development for $235 million and assumed operating control. With the sale of Randfontein Estates Ltd. to Harmony in 1999, Western Areas had no operating mines and had essentially become a holding company. In January 2000, the joint venture approved a 4-year, $340 million development plan that would commission the Modular Mill expansion in December 2001, the 2,946-m-deep South Deep Main shaft in July 2002, and the 2,790-m-deep South Deep Vent shaft in July 2004, which would increase the planned production from 135,000 t/mo to 220,000 t/mo of ore for treatment at an average recovered grade of around 8.3 g/t gold. Plans called for an incremental increase in salable production from 10,900 kg/yr of gold in 2000, to 14,300 kg/yr in 2001, to 19,000 kg/yr in 2002, and to 22,000 kg/yr in 2003; during 2000, actual production at the mine was 10,117 kg of gold. Productivity increases will be obtained with the phased change from conventional, labor-intensive reef mining to a minilongwall, bulk mechanized mining, which began in September 2000. This will decrease the size of production panel crews to 9 persons from 12 (South Deep, 2000, Placer Dome Western Areas Joint Venture, Factsheet of South Deep, accessed October 23, 2001, via URL http://www.southdeep.co.za).

Placer Dome reported proven and probable ore reserves as of December 31, 2000, at South Deep to be 107.8 Mt at a grade of 8.4 g/t plus additional measured and indicated mineral resources of nearly 70 Mt at a grade of 9.0 g/t and a projected mine life of about 72 years (Placer Dome Inc., 2001, Ore reserves and resources, Financial Results 2000, accessed October 22, 2001, at URL http://www.placerdome.com/investor/content/financials/download/ar00fr.pdf).

Iron and Steel.—*Iron Ore.*—In 2000, iron ore production in South Africa increased to 33.7 Mt, gross weight, which contained 20.9 Mt of iron; this was an increase of about 14% compared with that of 1999. Total sales of iron ore in 2000 totaled 33.75 Mt and were valued at about $438 million; of that total, 68% was exported, and 32% was shipped to domestic steel plants. Iscor Ltd. was South Africa's largest iron ore producer. Its two iron mines, Sishen and Thabazimbi, accounted for more than 80% of the country's total output. The Sishen Mine, which is in the Northern Cape Province, produced about 23 Mt/yr of contained iron ore at a grade of 65% iron, and the Thabazimbi Mine, which is in the Northern Province, 2 Mt/yr of contained iron ore at a grade of about 60% iron. Thabazimbi is a captive mine that supplies lump and fine iron ore to Iscor steel plants at Vanderbijlpark, which is outside of Johannesburg, and at Newcastle, which is in northern KwaZulu-Natal. At Sishen, 80% of iron ore production is railed to Saldanha Bay for export.

The Sishen Mine has commissioned a $100 million expansion program to increase its production capacity in two phases—from 24 Mt/yr to 30 Mt/yr of iron ore by 2003 and to 38 Mt/yr of iron ore by 2007. Concurrent with the expansion of the operation, the rail and port infrastructure associated with the Sishen-Saldanha exports will also be upgraded. Because Thabazimbi has a remaining mine life of only between 6 and 8 years, a prefeasibility study on replacing this production by developing the Welgevonden deposit was being conducted; this new mine, which is located some 60 km south of Sishen, contains a high-quality resource of 259 Mt of iron ore suitable for open pit mining (Iscor Ltd., 2001, Operations—Iron ore—Overview, accessed October 22, 2002, at URL http://www.kumbaresources.com).

Faced with heavy indebtedness from its steel investments, in March 2001, Iscor announced its intention to unbundle its assets and to spin off its coal, base metals, iron ore, and titanium heavy-minerals assets into the separate mining company Kumba Resources Limited as a wholly owned subsidiary. Iscor would remain as a separate steel company and use funds raised from the spin off of Kumba Resources to help retire more than $500 million in Saldanha Steel (Pty.) Ltd. debt; Saldanha Steel was a joint venture between Iscor (50%) and Industrial Development Corporation (IDC) (50%). The unbundling was subject to approvals by Government regulatory authorities (Iscor Ltd., 2001, Terms announcement—Announcements—Unbundling Iscor, accessed October 22, 2002, at URL http://www.iscor.co.za/restructure/index2.asp; David McKay, March 3, 2001, Iscor to unbundle, ease Saldanha Steel debt, Mining Web, accessed October 22, 2001, at URL http://m1.mny.co.za/MGFin.nsf/Current/4225685F0043D37A42256A020069A145?OpenDocument). In a related action in February 2001, Avmin acquired a 13.9% interest in Iscor for about $82 million (Anglovaal Mining Limited, February 1, 2001, Acquisition by Avmin of a 13.7% interest in Iscor Ltd. and formation of an alliance with IDC, Press Release, accessed October 22, 2001, at URL http://www.avmin.co.za/mediashop/pressrelease.asp?story=42).

Iron and Steel.—South African crude steel production increased by 3.9% to 7.02 Mt in 2000. The steel operations of Iscor, which was the largest producer, were set up into two business units. Its flat steel unit operates the steel plant at Vanderbijlpark, which produced 3.4 Mt/yr of steel; this represented 80% of the domestic market and 70% of Iscor's total steel volume. Its long steel unit had four operations located in Newcastle, Kwa-Zulu Natal Province, and in Dunswart, Pretoria, Vereeniging, Gauteng Province; they accounted for total sales of 1.7 Mt/yr of steel, half of which was exported.

Saldanha Steel operated its new steel plant at Vredenburg near Saldanha Bay at full production levels during 2000 for the first year. The $1.5 billion plant had the capacity to produce 1.25 Mt/yr of hot-rolled coil steel and was the world's first steel minimill to combine the Corex and the Midrex technologies (replacing blast furnace technology) and to be designed as an environmentally clean facility. In May 2001, production rates exceeded 90% of design capacity of 100,000 t/mo. For the financial year ending June 30, 2001, Saldanha Steel reported that sales volumes grew by 60% to 901,000 t of steel. Saldanha Steel began to roll for the first time significant tonnages of 1-millimeter thin-gauge hot-rolled coil, the product for which the plant was designed to give it its international competitive advantage. The 2000-2001 financial year was a difficult one for the company as it faced a 40% drop in hot rolled coil prices, a worldwide steel plant overcapacity, and anticompetition trade actions to protect their domestic steelmakers by the Canadian and the United States Governments. Forced to adjust its long term price forecast for steel, Saldanha Steel took an "impairment" provision against the carrying value of the company's assets of approximately $430 million, offset partially by a $110 million deferred tax provision [Saldanha Steel (Pty.) Ltd., August 13, 2001, Audited financial results for the year ended 30 June 2001, accessed October 22, 2001, at URL http://www.ssteel.co.za/download/Saldanha_Financial_2001.pdf].

U.S. steel producers were seeking a 54.7% duty on hot-rolled steel shipped by Saldanha Steel, which they claimed had benefited from government subsidies that gave it an unfair edge in the U.S. market. In addition, the U.S. steel producers wanted a 19% dumping duty imposed on the same product line from Saldanha Steel as well as all South African producers, which included Iscor, and Highveld Steel and Vanadium Corp. Ltd. (Highveld), which they contended were charging U.S. customers less than domestic producers [Simon Barber, August 17, 2000, US producers seek 54% duty on SA steel, Business Day (Johannesburg), accessed October 22, 2001, at URL http://www.bday.co.za/bday/content/direct/1,3523,742139-6078-0,00.html].

Columbus Stainless [a joint venture among Highveld, IDC, and Samancor (33.3% each)] had production capacity between 500,000 and 600,000 t/yr of cold rolled slab, plate, sheet, and coil depending on the product mix. For 2000, Columbus produced 531,812 t of slab steel, which was a 10.6% increase compared to that of 1999, and saleable production amounted to 433,907 t, which was a 15% increase compared with that of 1999. About 75% of production is exported. Highveld produced 947,588 t of carbon steel in 2000, compared with 797,489 t in 1999 from its plant at Witbank, Mpumalanga Province (Highveld Steel and Vanadium Corp, 2001, Financial information, Annual Report for 2000, accessed October 12, 2001, at URL http://www.highveldsteel.co.za).

Lead and Zinc.—During 2000, Anglo American produced 68,100 t of lead and 27,100 t of zinc compared with 73,800 t of lead and 31,200 t of zinc in 1999 from its Black Mountain Mine near Aggeneys, Northern Cape Province. The mine also produced around 10,000 t/yr of copper. Remaining ore reserves at Black Mountain were reported to be 8.1 Mt at a grade of 0.52% copper, 4.05% lead, and 2.36% zinc, and measured and indicated mineral resources, 14.1 Mt at a grade of 0.73% copper, 3.19% lead, and 0.7% zinc. Black Mountain has a remaining mine life of 13 years. Ore reserves at Anglo American's Gamsberg deposit were reported to be 145.3 Mt at a grade of 6.04% zinc (Anglo American plc, 2001, Reserves and resources, Annual Report for 2000, accessed October 24, 2001, at URL http://www.angloamerican.co.uk/report2000/Report/ReservesResources.html). In May 2000, Anglo American announced plans to invest $110 million in Black Mountain. The major element of the expansion project will be the sinking and equipping of a new vertical shaft from surface to a depth of 1,750 m together with associated underground development. The life of the mine will be extended to at least 2013. The ore body remains open in two directions; management anticipated that further resources will be identified, which would extend the life of the mine beyond 2013 (Anglo American plc, May 16, 2000, Anglo American announces major expansion at Black Mountain mine, Press Release, accessed October 23, 2001, at URL http://www.angloamerican.co.uk/news_detail.asp?news_item_number=63609).

The feasibility study on whether to invest $850 million to develop the Gamsberg zinc mine, mill, and smelter project that would have the capacity to produce 200,000 t/yr of *refined zinc* was to have been completed by mid-2000. By yearend, however, Anglo American had yet to commit to the project. The Gamsberg deposit is located 22 km from Black Mountain in Northern Cape Province (Anglo American plc, 2000).

Maranda Mining Co. (Pty.) Ltd. (owned by Metorex) operated the Maranda zinc-copper mine in the southwestern portion of the Murchison Greenstone Belt in the Northern Province. For the fiscal year ending June 30, 2001, Maranda milled at rate of 8,200 t/mo of ore at a head grade of 1.8% copper and 14.6% zinc. Production for the year of metal contained in concentrates was 6,190 t of copper and 22,921 t of zinc. On June 30, 2001, proved and probable reserves were estimated to be 0.3 Mt at a grade of 15.3% Zn and 1.5% Cu, while mineral resources, exclusive of reserves, totaled 0.74 Mt at a grade of 12.7% zinc and 1.6% copper (Metorex Ltd., 2001, Our companies—Maranda Mines, accessed October 18, 2001, at URL http://www.metorexgroup.com/Maranda.htm).

Manganese and Ferromanganese.—South Africa dominated the world manganese market as the largest producer of manganese and with approximately 80% of the world's reserve base of manganese ore. In 2000, the country produced 3.63 Mt, gross weight, of manganese ore and concentrates; these were primarily metallurgical grades that ranged from 30% to more than 48% manganese, which was a 16% increase compared with that of 1999. Billiton's Samancor Manganese Division produced 2.16 Mt of ore from its Mamatwan open pit and Wessels underground mines near Hotazel and 397,000 t of manganese alloys during the fiscal year ending June 30, 2001. About 40% of Samancor's manganese ore production was exported to ferroalloy producers worldwide. The remainder was converted into alloys at Samancor's Manganese Division works at Meyerton, Gauteng Province and into manganese metal by the Manganese Metal Co. Pty. Ltd. The Manganese Division, in turn, exported 85% of its production.

Assmang operated the Gloria and the Nchwaning underground manganese mines in Northern Cape Province. Assmang was investing $75 million to add a new shaft complex at the Nchwaning III Mine, which was expected to be operational by late 2003. The expanded Nchwaning operation will have a run-of-mine capacity of about 2 Mt/yr of manganese, which could extend its mine life by more than 20 years. Avmin reported total proved manganese reserves of 12.8 Mt at a grade of 44.61% manganese and 7.30% iron at both mines. Measured, indicated, and inferred resources were estimated to be 237 Mt at a grade of 41.24% manganese and 7.98% iron (Anglovaal Mining Ltd., 2000, Mineral resources and reserves, Annual report for 2000, accessed October 22, 2001, at URL http://www.avmin.co.za/investor/mineralresources.asp). For 2000, Assmang sales included 1.36 Mt of manganese ore compared with 1.47 Mt in 1999 and 207,000 t of manganese alloys compared with 156,000 t in 1999. Ferromanganese production comes from Assmang plants at Cato Ridge near Durban and Machadadorp near Middleburg.

Nickel.—South Africa's nickel production was in the form of metal, metal-in-concentrate, and sulfate. Since 1998, the nation's nickel output, which has primarily been produced as a byproduct of PGM and copper processing, has included primary production from the new Nkomati nickel mine. In 2000, domestic sales of nickel, primarily to the stainless steel plants, amounted to about $171 million; export sales of nickel were valued at more than $116 million. During 2000, the Nkomati Joint Venture [controlled by Avmin (75%)] milled 189,000 t of ore, that produced 37,104 t of concentrate with an average nickel grade of 10.10%. This resulted in final metal production levels of 3,700 t of nickel and 1,400 t of copper. The mine remained at the lower end of the international cost benchmark. At yearend, the joint venture was evaluating the results of a feasibility study to assess the potential of an openpit expansion to include the large low-grade reserve base in three adjacent ore bodies at the mine (Anglovaal Mining Ltd. 2001, Review of operations—Base metals, Annual Report 2000, accessed October 23, 2001, at URL http://www.avmin.co.za/annualreport2000/roo-basemetals.asp).

Platinum-Group Metals.—In 2000, South Africa's production of PGMs, which originated almost exclusively from mines in the Bushveld Complex north of Pretoria, accounted for a dominant share of world production of these commodities, which included rhodium and other PGMs (88%), platinum (74%), and palladium (32%). Additionally, South Africa possessed around 88% of the identified global reserve base of PGMs. In 2000, South Africa produced 206,770 kg of PGMs and exported 198,944 kg valued at $3.9 billion. Export shipments included 114,459 kg of platinum, 55,818 kg of palladium,19,427 kg of ruthenium and 12,067 kg of rhodium. The PGM industry employed more than 96,000 workers in 2000.

Since 1997, the global PGM market dynamics, which have been significantly affected by shortfalls in Russian PGM production and exports, have created major incentives for South African producers to expand production. The Bushveld PGM ores are much higher in platinum than the Russian nickel-copper-PGMs ores mined at the Norilsk nickel complex in Siberia, which have a 3:1 palladium-to-platinum ratio. By comparison, 1999 production data from South Africa showed a 0.48 to 1 palladium-to-platinum ratio. As the market leader, South Africa has contributed to moderating the rise in average annual platinum prices by only 139% to $549.31 per troy ounce in 2000 from $396.59 per troy ounce in 1997. By comparison, the Norilsk nickel mine in Russia contains ores that are higher in palladium and rhodium and has been the dominant producer of these commodities. Between 1997 and 2000, the disruption of Russian supply has driven up the average annual price of palladium by more than 376% to $692 per troy ounce and that of rhodium by more than 668% to $1,990 per troy ounce. A U.S. Geological Survey analysis of industry investment plans shows that more than $3.5 billion was projected to be spent in South Africa on adding 98,600 kg (3.17 million troy ounces) in new capacity that will bring total PGM production capacity in South Africa to 246,300 kg (7.92 million troy ounces) between 2000 and 2007.

The Anglo American Platinum Corp. Ltd. (Anglo Platinum) was the largest PGM producer in the world at about 37% of global platinum supply, all from South African operations. Anglo Platinum's production came from three operating subsidiaries—Rustenburg Platinum Mines Ltd., Potgietersrust Platinums Ltd., and Lebowa Platinum Mines Ltd. in Northwest and Northern Provinces. Facilities include six mines and three processing plants—the Waterval Smelter complex, the Rustenburg Base Metals Refinery, and the Precious Metals Refinery. Production of the minor platinum-group elements (PGEs) was not reported.

As of December 31, 2000, Anglo Platinum reported total proved mineral reserves of 145.56 Mt at a grade of 5.17 g/t based on four PGEs; probable mineral reserves of 1,349 Mt, at a grade of 4.8 g/t based on four PGEs; and indicated mineral resources of 1,624 Mt, at a grade of 5.34 g/t based on four PGEs (Anglo American Platinum Corp. Ltd., 2001, Mining operations—Combined ore reserves, Annual Report 2000, accessed October 24, 2001, at URL http://www.angloplatinum.com/for_invest/fi_annual_rep/ar_00/amplats_ar_2000/minoprev/def_minop.htm). Grades are reported as the total grams per metric ton of from three to five PGEs, which include platinum, palladium, rhodium, ruthenium, and osmium, in order of importance. These resources were being used as a base to expand production to 108,862 kg (3.5 million troy ounces) of platinum by 2006. Capital expansion investment for 2000 was $193 million with more than $450 million projected for 2001. Major expansion projects included the following:

- Completion of the $173 million Bakofeng-Rasimone Mine by the first quarter of 2002. The mine is designed to treat 2.4 Mt/yr of ore that will yield 7,776 kg/yr of platinum. The mine life will be 25 years.
- The $22 million Amandelbult Mine UG2 expansion was completed in 2000. Amandelbult will treat 720,000 t/yr of ore that will yield 2,239 kg/yr of platinum. The mine life will be 80 years.
- The $12 million Lebowa Middlepunt Hill expansion was completed in 2000. Middlepunt Hill will treat 660,000 t/yr of ore that will yield 1,089 kg/yr of platinum. The mine life will be 8.5 years.
- Development of the new Maandagshoek Mine at a capital cost of $195 million by the third quarter of 2002 will add 5,039 kg/yr of new platinum production during a 30-year mine life with potential for expansion.
- The Waterval project will invest $190 million to expand UG2 mining at the Rustenburg section to produce 12,286 kg/yr for more than 30 years. Completion is expected by the end of 2002.
- The $60 million UG2 expansion project at the Union section will expand production to 2,923 kg/yr of platinum for more than 30 years by the first quarter of 2003.
- A new converter process will be installed at the Waterval Smelter to increase capacity and to reduce sulfur dioxide emissions. With a capacity of 72,000 t/mo of converter matte, the plant will be able to treat material that contains 33,000 t/yr of nickel, which equates to around 124,400 kg/yr of platinum. Capital cost will be around $160 million with completion scheduled for 2004.
- In February 2001, Anglo Platinum authorized construction of a new $145 million smelting complex at Pietersburg in the

Northern Province. The plant will be designed to treat 650,000 t/yr of concentrates with completion expected in 2002 (Anglo American Platinum Corp. Ltd., 2001, Business development review, Annual report for 2000, accessed October 24, 2001, at URL http://www.angloplatinum.com/for_invest/fi_annual_rep/ar_00/amplats_ar_2000/ default.htm).

In 2000, Impala Platinum Holdings Limited (Implats), which was the second largest producer in South Africa, held majority interests in the Impala Platinum operations, in the Canadian junior mining company Platexco Inc., and Barplats Mines Ltd. as well as minority interests in Aquarius Platinum Ltd. and the Two Rivers Platinum (Pty) Ltd. joint venture (Avmin, 55%; Implats, 45%). Implats operated 13 shafts within the Merensky and UG2 Reefs, a concentrator, smelter, an enhanced precious metals refinery, and a base metals refinery. For the financial year ending June 30, 2001, Implats produced 58,381 kg of refined PGMs, of which 31,166 kg was platinum; there was a 2% decrease from that of the previous financial year. The decrease was attributed to delays in commissioning of the new concentrator circuit for UG2 plant expansion. The smelter upgrade, which comprised two new converters, the enhanced acid plant and a new 38 megawatt (MW) furnace, was completed during the year. These expansions were the first step in Implats' plans to expand production at a rate of 10% per year.

Impala planned on investing $486 million between 2000 and 2004 to maintain its in-house capacity at the 31,110 kg/yr level until 2030. The phased projects, which were designed to access more than 112 Mt of ore reserves, include five decline shafts and a vertical shaft to link in with the No. 12 shaft. Future expansions also included the Winnaarshoek project, which Implats acquired with the $136 million takeover of Platexco in December 2000. The $230 million Winnaarshoek project included development of the Platexco property along with adjacent land acquired in a mineral rights swap with Amplats. Production was expected to begin in 2002 with full production of 5,443 kg/yr of PGMs expected by 2004. Barplats Crocodile River Mine was brought into production during December 2000. By March 2001, the mine was operating at the planned rate of 75,000 t/mo of ore designed to produce 1,555 kg/yr of platinum at a capital cost of $40 million.

The Two Rivers joint venture acquired the PGM rights to the Dwars Rivier farm, near Lydenburg, for $70 million in May 2001 and planned on investing an additional $60 to $85 million to bring into production at least 3,110 kg/yr of PGMs by 2004 (Business Day, May 30, 2001, Avmin, Implats in R551m platinum deal, accessed October 24, 2002, at URL http://www.bday.co.za/content/direct/1,3523,858927-6079-0,00.html; Impala Platinum Holdings Limited, 2001, Chief executive officer's review, Annual report for 2001, accessed October 24, 2002, at URL http://www.implats.co.za/annual_report/2001/chief_exercutive_officers_review.html; Impala Platinum Holdings Limited, 2001, Review of operations, Annual report for 2001, accessed October 24, 2002, at URL http://www.implats.co.za/annual_report/2001/impala_platinum.html).

A detailed breakdown of Implats PGM ore reserves was presented in its 2001 annual report (Impala Platinum Holdings Limited, 2001, Reserves and resources, Annual Report for 2001, accessed October 24, 2002, at URL http://www.implats.co.za/annual_report/2001/reserves_and_resources.html).

Lonmin plc, which is the third largest PGM producer in the world, operated three mines, a smelter, a base-metals smelter, and a precious metals refinery. During 2000, the company divested its nonmining interests and restructured itself as a focused PGM producer. For the financial year ending September 30, 2000, Lonmin mined and treated 9.7 Mt of ore with an average yield of 4.19 g/t PGMs. The upward trend in production continued with refined output at 20,521 kg of platinum, 9,122 kg of palladium, and 2,762 kg of rhodium. Proven mineral reserves were reported to contain 80,870 kg (2.6 million troy ounces) of five PGEs plus gold and probable mineral reserves 244,785 kg (78.7 million troy ounces) of five PGEs plus gold. Expansion projects underway in 2001 included a new incline shaft at the Eastern Platinum Mine, a new Karee-B concentrator, two new vertical shafts at the Eastern Platinum and the Karee Mines, and construction of a new smelter furnace. The company announced plans in 2000 to increase production by 43% within a 7 year period to 27,060 kg/yr of platinum at a capital cost of $550 million, which they expect to cover from cash flow (Lonmin plc, 2000, Review of operations—Platinum, Annual Review 2000, accessed October 24, 2001, at URL http://www.lonmin.com/files/Lonmin2000_Annual_Review.pdf).

Aquarius Platinum Ltd. of Australia had interests in the Kroondal Mine and the Marikana and the Everest South PGM projects in North West Province, which they planned to develop so that 15,550 kg/yr of platinum could be produced by 2003. Kroondal Platinum Mines Ltd. [controlled by Aquarius (55%) and Implats (45%)] commissioned its $56 million Kroondal PGM mine in mid-1999. During its first full year of operation in 2000, Kroondal produced 1,533 kg of platinum, 707 kg of palladium, and 236 kg of rhodium, all in concentrates, which were sold to Implats for refining. Bulk mining methods were employed to keep productivity high and operating cost low. Reserves were sufficient for 14 years of operation at this rate. Measured reserves in two seams were reported to be 2.6 Mt, at a grade of 5.8 g/t PGEs, and indicated reserves, to be 13.3 Mt, at a grade of 6.3 g/t PGEs. Kroondal Platinum entered a 50-50 joint venture with Anglo Platinum's Rustenburg Division to expand Kroondal production to 15,550 kg/yr of PGMs, which would include 9,330 kg/yr of platinum, by 2002 with a contribution of adjacent Rustenburg UG2 mineral rights. Following a favorable feasibility study in 2000, Aquarius decided to begin development of the Marikana project in 2001 on the basis of a UG2 resource of 21.36 Mt at a grade of 4.41 g/t PGMs. The $70 million development will produce 4,980 kg/yr of PGMs in concentrates containing 2,924 kg of platinum, 1,483 kg of palladium, and 529 kg of rhodium that will be sold to Implats. At the Everest South project, exploration drilling in the UG2 Reef has identified an undiluted resource of 36.3 Mt, at a grade of 4.7 g/t PGMs. A feasibility study on developing Everest South will be conducted during 2001. Aquarius Platinum reported total resources to be 95.4 Mt at a grade of 4.8 g/t PGMs at all three properties (Aquarius Platinum Ltd., 2001, Kroondal platinum mine and projects—Marikana and Everest South, 2000 Annual Review, accessed October 24, 2001, at URL http://www.aquariusplatinum.com/documents/A00.pdf).

Northam Platinum Ltd. (Northams) operated the Northam Mine and processing plant near Anglo Platinum's Amandelbult section. The economic empowerment company Mvelaphanda Platinum Ltd. held a 22.5% interest in Northams, and Anglo Platinumheld a 20% interest. During the year ending June 30, 2001, Northams treated 1.9 Mt of ore that yielded 5.4 g/t of three PGEs plus gold. Production included 8,725 kg of three PGEs plus gold in concentrates, 1,625 t of nickel, and 827 t of copper. Sales were reported to be 5,235 kg of platinum, 2,475 kg of palladium, 414 kg of rhodium, and 183 kg of gold. Construction of the concentrator for the UG2 expansion project was completed in November 2000 and commissioned in January 2001 (Northam Platinum Ltd., 2001, Operational review, 2001 Annual Report, accessed October 24, 2001, at URL http://www.northam.co.za/annual_report/2001/review_of_ops.html). Northams reported resources on the Merensky Reef to be proved and probable reserves of 38.1 Mt at a mill head grade of 5.7 g/t PGMs and measured and indicated resources of 55.6 Mt at an in-situ grade of 7.3 g/t PGMs. UG2 Reef assets were estimated to be proved and probable reserves of 21.8 Mt, at mill head grade of 3.8 g/t PGMs and measured and indicated resources of 71 Mt at an in-situ grade of 4.7 g/t PGMs (Northam Platinum Ltd., 2001, 2001 Resources and reserves, Annual Report, accessed October 24, 2001, at URL http://www.northam.co.za/annual_report/2001/resources_and_reserves.html).

SouthernEra Resources Ltd. began development of the $86 million Voorspoed section of its Messina Platinum Mine in 2000; completion was expected in early 2003. The mine was scheduled to produce 4,945 kg/yr of four PGEs plus gold, which will include 2,147 kg/yr of platinum, 1,697 kg/yr of palladium, 551 kg/yr of ruthenium, 263 kg/yr of rhodium, and 123 kg/yr of iridium. Additional byproduct credits will include 170 kg/yr of gold, 1,860 t/yr nickel, 1,111 t/yr copper, and 30 t/yr cobalt. A mine life of more than 50 years was expected. A second ore body, the Doornvlei section, held potential for future expansion of the Messina Mine (SouthernEra Resources Limited, 2001, The Messina platinum project, accessed October 25, 2001, at URL http://www.southernera.com/messina.htm). Total resources identified by the end of 2000 for the Messina project at the Doornlei, the Voorpoed, and the Zebediela ore bodies and reported as five PGEs plus gold included measured resources of 26.4 Mt at a grade of 6.3 g/t, indicated resources of 15.2 Mt at a grade of 5.81 g/t, and inferred resources of 45 Mt at a grade of 5.3 g/t (SouthernEra Resources Limited, 2001, Report of operations—Messina platinum project, Annual report for 2000, accessed October 25, 2001 at URL http://www.southernera.com/SUFannual2000.pdf).

Other companies active in PGM exploration and development projects during 2000 included African Minerals Ltd., a private affiliate of Ivanhoe Capital Corporation, Anooraq Resources Corp.'s Platreef project (http://www.hdgold.com/arqstart.htm), Cluff Mining PLC. (http://cluff-mining.com), Pan Palladium Ltd. (http://www.minesite.com/companies/pan_palladium.htm), Pinnacle Resources Inc. (http://www.pnrr.net), and Thabex Exploration Ltd. (http://www.thabex.com).

Titanium and Zirconium.—Globally, South Africa ranked second in titanium production and third in titanium exports in 2000. Richards Bay Minerals (owned jointly by Rio Tinto and BHP Billiton) produced ilmenite, rutile, and zircon from beach sands north of Richards Bay. Richards Bay Minerals was the trading name for two registered companies—Richards Bay Iron and Titanium (Pty) Ltd (RBIT) and Tisand (Pty) Ltd. Tisand is responsible for the dune mining operation and mineral separation. RBIT, which is responsible for the smelting and beneficiation process, produced an 85% titanium dioxide slag from ilmenite concentrates at the Richards Bay smelter as well as low-manganese pig iron. The flow sheet for the operation was available on the company Web site accessible at URL http://www.richardsbayminerals.co.za. The Richards Bay operation was the largest titanium mineral producer in the country with production in the range of 1 Mt/yr of titanium dioxide slag.

Namakwa Sands Limited operated a heavy-mineral sand mine at Brand-se-Baai and a mineral separation plant at Koekenapp, which is located 340 km northwest of Cape Town, and a smelter at Vredenburg, which is near the export harbor at Saldanha Bay. Production in 2000 was up about 30% from 1999 and included 112,700 t of titanium chloride slag, 106,800 t of zircon, 71,600 t of pig iron, 27,200 t of titanium sulfate slag, and 23,200 t of rutile. Remaining resources at Namakwa Sands at yearend 2000 were 761 Mt at a grade of 3% ilmenite, 0.5% zircon, and 0.25 rutile (Anglo American plc, 2001, Reserves and resources, Annual Report for 2000, accessed October 20, 2001, at URL http://www.angloamerican.co.uk/report2000/Report/ReservesResources.html).

Titaniferous magnetite also was recovered at the Phalaborwa carbonatite as a byproduct of copper and phosphate rock production. Titaniferous slag was produced from Mapoch Mine magnetite ores at Highveld's Witbank steel plant. Iscor's Heavy Minerals business unit (60%) in partnership with Ticor Ltd. of Australia (40%) was proceeding with development of its $275 million Heavy Minerals project which will consist of a mine and a concentrator at Hillendale and a mineral separation plant and a smelter at Empangeni, both are near the Richards Bay deep-sea port in the KwaZulu-Natal Province. The project design calls for production of 550,000 t/yr ilmenite, 250,000 t/yr of titanium slag, 145,000 t/yr pig iron, 100,000 t/yr zircon, and 40,000 t/yr rutile by 2005 (Iscor Ltd, 2001, Locations—Hillendale and Empangeni, accessed October 23, 2001, at URL http://www.iscor.co.za).

Zirconium was produced as a zircon byproduct of mining at the Richards Bay and the Namakwa Sands mineral sands operations. Palabora produced 70% of the world's baddeleyite, which is a zirconium sulfate mineral used in specialized applications in the ceramics, refractory, and tanning industries and in kidney dialysis machines. During 2000, Palabora mined 8,526 t of baddeleyite compared with 7,486 t in 1999. Production of zirconium sulfate tetrahydrite was 1,769 t, and that of grade 5, which is a milled baddeleyite, 2,497 t (Palabora Mining Company Limited, 2001).

Vanadium and Ferrovanadium.—South Africa was the world's largest producer and exporter of vanadium. Vanadium was produced from titaniferous magnetite mined from the Bushveld Complex. The largest producer was Highveld Vanadium and Chemicals. From calendar years 1999 to 2000, Highveld's production of vanadium slag increased by 22% to 70,372 t and of ferrosilicon, by 2% to 55,629 t (Highveld Steel and Vanadium Corp. Ltd., 2001, Group salient information, Annual Report 2000, accessed October 30, 2001, at URL http://www.highveldsteel.co.za/Financial/Files/Highveld.pdf).

Xstrata, which was the second largest South African producer of vanadium, acquired both Rhombus Vanadium Holdings Ltd. and Vanadium Technology (Pty.) Ltd. (Vantech) in 1997. Although Xstrata produced 20% more vanadium pentoxide in 2000, it struggled with low world market prices and reduced sales and revenues, which were offset by higher chrome revenues. During 2000, 27,781 t of vanadium pentoxide and 1,070 t of ferrovanadium were produced (Xstrata AG, 2001, Financial review, Annual Report 2000, accessed October 25, 2001, at URL http://www.xstrata.com/reports/2000-en/financial_review.php).

Industrial Minerals

South Africa produced about 30 different industrial minerals from 530 mines and quarries, about half of which were devoted to aggregate and sand production. The industrial minerals sector was a significant contributor to total mineral sales. In 2000, the value of total sales of industrial minerals produced decreased by 3% in rand terms and by more than 13% in dollar terms to $602 million, compared with $696 million in 1999. Approximately 68% of those sales was on the domestic market. In terms of sales, the three dominant industrial mineral commodities were aggregate and sand, limestone and dolomite, and phosphate rock. The largest domestic consumers of South Africa's industrial minerals were the building and construction, metallurgical, and agricultural sectors. Total export earnings for industrial minerals were than $194 million in 2000. Granite and norite dimension stone accounted for 47% of industrial mineral exports; the other major export commodities were, by value, vermiculite, phosphate rock, andalusite, andalusite, and asbestos (Duval, Luitingh, and Ratabala, 2001).

Cement.—The expected 3% to 4% growth in demand for cement failed to materialize in 2000; this followed a weak year for residential building and for large civil engineering projects, aggravated by serious floods early in the year. Domestic sales of cement were 7.9 Mt in 2000, essentially the same as those of 1999 but 1 Mt less than those of 1997. The major consuming provinces were Gauteng (34.3%), Kwa-Zulu Natal (15.4%), and Western Cape (13.8%). Export sales of cement to the neighboring states of Botswana, Lesotho, Namibia, and Swaziland declined slightly by 1.2% to 1.09 Mt in 2000 (Cement and Concrete Institute of South Africa, 2001, Market review 2000, Cement and Concrete Review, accessed October 16, 2001, at URL http://www.cnci.org.za/annual_review_2000/market_review.htm).

Diamond.—Rough diamond production increased by 9% in 2000 to 10.8 million carats. As in years past, mines owned by De Beers dominated the sector with more than 90% of the total production. Total diamond production for De Beers' South African operations in 2000 amounted to 10.29 million carats recovered from 23.3 Mt of material treated. The Venetia Mine, which was the largest De Beers operation, recovered 4,497,756 carats with a revenue of $55 per carat; the Finsch Mine, 1,925,059 carats at $50 per carat; the Premier Mine, 1,782,420 carats at $46 per carat; the Namaqualand Mine, 809,928 carats at $159 per carat; the Kimberley Mine, 568,639 carats at $76 per carat; the Marsfontein Mine, 436,191 carats at $165 per carat; the Koffiefontein Mine, 151,498 at $228 per carat, and the Oaks Mine, 116,048 carats at $165 per carat. Recovered diamond grades varied considerably within the De Beers operations during 2000—with 122 carats per 100 metric tons recovered at Venetia, 82.2 carats per 100 tons at Marsfontein, 62.6 carats per 100 tons at Premier, 54.7 carats per 100 tons at the Oaks, 45.8 carats per 100 tons at Finsch, 16.2 carats per 100 tons at the Kimberley Mine, 13.2 carats per 100 tons at the Namaqualand Mine, and 6.9 carats per 100 tons at the Koffiefontein Mine (De Beers Consolidated Mines Ltd., 2001, Review of operations—Mining and recovery, Annual Report for 2000, accessed October 20, 2001, at URL http://www.debeersgroup.com/dbInvestor/AR2000/AR2000ReviewOfOperations.pdf). At Kimberly, De Beers was examining the feasibility of extending the life of the Dutoitspan Mine by 6 years by replacing its 40-year-old treatment plant with newer, more efficient technology, that would permit recovery from old surface dumps and previously uneconomic underground reserves.

During 2000, SouthernEra Resources Ltd. of Canada announced plans to develop its third diamond mine the Klipspringer; completion is expected by 2004. The underground development will produce 160,000 carats per year at a capital cost of $7 million. On the basis on a minable reserve of 3.6 Mt at an average recovered grade of 47 carats per 100 tons, valued at $100 per carat, the Klipspringer project will have a mine life of more than 13 years. Ore will be treated at SouthernEra's existing dense-medium separation plant at Klipspringer (SouthernEra Resources Ltd., August 24, 2000, Positive feasibility study completed for Klipspringer diamond project, Press Release, accessed October 24, 2001, at URL http://www.southernera.com/News_Releases/nr000824.htm).

Fluorspar.—In 2000, the two main producers of fluorspar were Vergenoeg Mining Company (Pty.) Ltd. (owned by Metorex) and Witkop Fluorspar Mine (Pty.) Ltd. [owned by the Australian company South Africa Land & Exploration Company (Sallies)]. Also during 2000, International Metal Processing of South Africa reopened the old Buffalo Fluorspar Mine, which was expected to produce more than 120,000 t/yr of acid-grade fluorspar (International Metal Processing, 2001, The Buffalo plant—Fluorspar, accessed October 11, 2001, at URL http://www.intmetals.com/BuffaloPlant.htm).

The open pit Vergenoeg Mine, which is located 70 km north-northwest of Pretoria, milled 51,000 t/mo of ore at a head grade of 38% calcium fluoride. Production was approximately 16,400 t/yr of metallurgical-grade fluorspar and 103,600 t/yr of acid-grade fluorspar. As of June 30, 2001, mineral reserves were reported to be 4.6 Mt at grade of 36.8% calcium fluoride (CaF_2) plus mineral resources of 151 Mt (Metorex Ltd., 2001, Our companies—Vergenoeg, accessed October 18, 2001, at URL http://www.metorexgroup.com/Vergenoeg.htm).

Sallies purchased the Witkop Mine from Phelps Dodge Corp. of the United States for $12 million in 1999. Capacity from four quarries and a flotation plant was 140,000 t/yr of acid-grade fluorspar. A feasibility study was underway to examine the potential for doubling capacity to 240,000 t/yr of fluorspar. Resources at the Witkop Mine and the nearby Buffelshoek Farm deposit were reported for Witkop as measured reserves of 14 Mt at a grade of 15% CaF_2 at a stripping ratio of less than 2 to1 and indicated resources of 3.5 Mt at a stripping ratio of 2 to 1. The Buffelshoek deposit had measured reserves of 7.5 Mt at a grade of 18% CaF_2 at a stripping ratio of less than 2 to1 and indicated resources of 9 Mt at a grade of 15% CaF_2. Inferred resources at depths of 50 to 200 m, which were currently uneconomic to mine underground in 2000, have been estimated to be around 750 Mt, which made the Witkop deposit one of the largest fluorspar deposits in the world (Jansen, 2001).

Vermiculite.—The major producer was the Vermiculite Operations Division of Palabora, which extracted vermiculite from the pyroxenite units of the mineralogically diverse Phalaborwa Carbonatite Complex. The company reported vermiculite concentrate production of 208,422 t at a grade of 90.65% vermiculite in 2000; this represented about 75% of reported world supply.

Mineral Fuels

Coal.—Following platinum and gold, coal was one of the most important sectors of the mineral economy of South Africa. South Africa remained the fifth largest coal-producing country in the world and the third largest coal exporter. Production and export levels continued on an upward trend in 2000. About 55 mines produced 222.9 Mt of coal valued at $2.84 billion; of this total, 68.6 Mt valued at $1.57 billion was exported primarily through the Richards Bay Coal Terminal (RBCT). Export destinations for South African coal were in order of importance Europe, Asia and the Middle East, Africa, and South America. The RBCT was undertaking a major investment program to increase the Richards Bay port coal export capacity progressively to 81 Mt/yr by 2010. More than 80% of saleable coal production was controlled by three companies—Ingwe Coal Corp. Ltd. (36%), Anglo American Coal Corp. Ltd. (24%), and Sasol Mining (Pty.) Ltd. (21%). In 2000, 162.8 Mt of coal was consumed domestically. The majority of domestic sales went to electricity (93.36 Mt) and industry (51.51 Mt). South Africa's coal reserves were mainly bituminous with relatively high ash content (about 45%) and low sulfur content (about 1%). Three fields—Highveld, Waterberg, and Witbank—hold 70% of total recoverable reserves. Several areas, which included parts of the Waterberg Field, were identified as having potential for future coal bed methane development (U.S. Energy Information Administration, 2000, South Africa—Energy, Country Analysis Brief, accessed February 17, 2000, at URL http://www.eia.doe.gov/emeu/cabs/safrica.html). The estimate of recoverable coal reserves of 55.3 Gt was last calculated in 1987. The DME was conducting a new evaluation of coal resources and reserves to be based on guidelines from the United Nations Economic Commission for Europe Standards and Proposals. The new evaluation will also include an assessment of the recovery of usable energy from coal discard dumps. In 1998 alone, 62 Mt of discard coal was generated.

Petroleum and Natural Gas.—Soekor controlled all offshore oil and gas prospects. In 2000, the ORCA, which is a floating production, storage, and off-loading (FPSO) vessel, produced more than 6.6 million barrels of 42° API crude petroleum from the Oribi Field, which was commissioned in 1997, and the newly commissioned (May 2000) Oryx Field. The ORCA, which operated about 140 km offshore from the town of Mossel Bay, was producing at a rate of 25,000 barrels per day (bbl/d) of crude petroleum; 10,000 bbl/d came from the Oryx Field. Seventeen kilometers to the west, Soekor discovered oil and gas in five wells drilled in the Sable Field; field development studies suggested the potential to produce 40,000 bbl/d from the Sable Field. Soekor was seeking to lease the Sable Field to a major contractor, which would supply a new FPSO and operate the oilfield [Soekor E and P (Pty.) Ltd., 2001, Oil production, accessed October 16, 2001, at URL http://www.soekor.co.za/produce.htm].

Mossgas, which used natural gas to produce synthetic motor fuel at its plant at Mossel Bay, produced natural gas from several offshore fields under mining leases from Soekor. The F-A Field, discovered by Soekor in 1984 and situated 85 km south of the town of Mossel Bay, was producing at an average rate of 5.49 million cubic meters per day of natural gas and 9,500 bbl/d of condensate. The E-M gasfield, which is situated 50 km west of F-A, was commissioned by Mossgas in September 2000. Combined with several other smaller fields in the area, gas resources were sufficient to supply Mossgas until 2008. Separate 91-km pipelines convey gas and condensate to the Mossgas synfuels plant where petrol, diesel, and kerosene were produced at a rate of 36,000 bbl/d of finished product [Soekor E and P (Pty.) Ltd., 2001, Exploration—Oil and gas discoveries, accessed October 16, 2001, at URL http://www.soekor.co.za/explore.htm].

Synthetic Fuels.—South Africa had a highly developed synthetic fuels industry, that took advantage of the country's abundant coal resources and offshore natural gas and condensate in Mossel Bay. The two major players were Sasol (coal-to-oil and chemicals), which was the world's largest manufacturer of oil from coal, and Mossgas (natural-gas-to-petroleum products). Sasol had the capacity to produce 150,000 bbl/d, and Mossgas, 45,000 bbl/d. The Government ended Sasol's $150 million per year subsidy in July 1999; the subsidy was to protect it against cheaper imported crude oil. Sasol's coal liquefaction plants were located at Secunda (oil) and Sasolburg (petrochemicals). Started by the Government in the 1950s to help reduce South Africa's dependence on imported oil, the company was privatized in 1979. In the coal liquefaction plants, coal is first gasified, then turned into a range of liquid fuels and petrochemical feedstocks. During 2000, Sasol initiated plans to replace coal with natural gas as the feedstock for its conversion process. Sasol estimated that the switch to natural gas, which will entail the construction of a 893-km pipeline to transport gas from the Pande and the Temane gasfields in Mozambique to Sasolburg and Secunda, could be completed within 3 years. In October 2000, Sasol and the Mozambican Government signed three accords that allow for construction of the pipeline and transport of the natural gas out of Mozambique. Sasol was also granted the rights to explore for additional hydrocarbons in the area around the Pande and the Temane gasfields. A regulatory framework for the project was agreed upon in December 2000. Construction on the $500 million pipeline was expected to begin in June 2001 (U.S. Energy Information Administration, December 2000, South Africa—Energy, Country Analysis Brief, accessed

October 17, 2001, at URL http://www.eia.doe.gov/emeu/cabs/safrica.html).

Reserves

South Africa's mineral reserves are large and varied and reflect the country's complex geology. A detailed description of the geology and mineral resources of South Africa was updated by the Council for Geosciences in 1998 (Wilson and Anhaeusser, 1998). The bulk of South Africa's mineral production is from the northern half of the country. Table 3 lists the reserve base for a number of South Africa's major minerals. Although data for many of the minerals listed are incomplete for the world, South Africa's reserves appear to rank among the top five countries and would rank first in the world for andalusite, chromite, gold, manganese, PGMs, and vanadium.

Infrastructure

The country has a well-developed and extensive road and railroad infrastructure that served not only South Africa but also the surrounding region. Roadways totaled 331,265 km, of which 137,475 km was paved. Railroad infrastructure totaled 21,431 km, of which 9,087 km was electrified. Portnet maintained the largest and most efficient commodity export harbors in sub-Saharan Africa, most of which handled minerals, notably Cape Town, Durban, East London, Mossel Bay, Port Elizabeth, Richards Bay, and Saldanha Bay. In addition to fulfilling the requirements of South Africa itself, the country's ports also served as outlets for such landlocked countries as Botswana, Lesotho, Swaziland, Zambia, and Zimbabwe. South Africa was also a regional supplier of electricity and petroleum products, two of a number of examples of the dependence of neighboring countries on South Africa's infrastructure and transportation networks.

Richards Bay handled more than half the volume of cargo among South African ports. The RBCT had a coal export capacity of about 68 Mt/yr out of a total bulk cargo port capacity of 75 Mt/yr. A second coal export facility was being built at South Dunes near Richards Bay to handle an additional 12 Mt/yr of coal exports. Coal exports through Durban and the Mozambican port of Maputo were only a fraction of those through the RBCT. Durban's port facilities were designed mainly for small consignments of high-quality lump bituminous coal and anthracite that cannot be properly handled at Richards Bay.

Eskom had a nominal capacity of 41,298 MW, predominantly from coal-fired sources, with a small percentage of electricity being generated from nuclear sources, and operated more than 306,100 km of power lines (Eskom, 2001, Key statistics, Annual Report for 2000, accessed October 22, 2001, at URL http://www.eskom.co.za/annreport01/home.htm). South Africa maintained 931 km of pipeline for the distribution of crude oil, 1,748 km for petroleum products, and 322 km for natural gas.

Outlook

South Africa is endowed with one of the richest and diverse concentrations of mineral resources on Earth and has, in terms of size and value, one of the top 10 mining and mineral-processing industries in the world. Contributing to more than 25% of the country's GDP, the minerals sector is expected to continue to play an important role in the economy for many years to come. The Government is successfully balancing the needs to focus policy initiatives and budget resources on redressing social and economic inequities in the country with the need to maintain economic and labor polices which allow South African exports to remain competitive in global markets. As a sign of confidence in the future of South Africa, domestic and foreign mineral investors have announced plans to commit more than $10 billion to develop or expand new mining and value-added mineral processing capacity between 2000 and 2007. These planned investments, however, are subject to internal and external forces that could delay or constrict actual implementation. Internally, the impact of the high rate of HIV/AIDS in the country on the able-bodied skilled and semiskilled work force between 15 and 49 and on the resulting increasing direct and indirect labor costs to industry are of concern to investors. Externally, the weak global economy is impacting negatively on demand and prices of mineral commodities and are making many projects marginally economic to continue. Increased attention was being given to environmental issues, which are also factors in projects that require financing from international lending institutions. By mid-2000, evidence indicated that many companies were beginning to rethink the timing of future investments, particularly in ferrous and base-metal projects. These factors make it even more critical for the South African Government to maintain the investment policies and economic incentives that will allow South Africa to compete for investment with the other major mineral-export-oriented-countries, such as Australia and Canada.

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Internet: http://www.mepc.org.za
National Union of Mineworkers
P.O. Box 2424
2000 Johannesburg, South Africa
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Fax: (27) (11) 836-0201
Internet: http://www.anc.org.za/num

Major Publications

Chamber of Mines of South Africa:
Annual Report.
Statistical Tables, annual.
Department of Mineral and Energy Affairs, Annual Report.
Mineral Economics Directorate (Minerals Bureau):
South Africa's Mineral Industry, annual.
Operating Mines and Quarries and Mineral Processing Plants in the Republic of South Africa, various periodic directories.
Mineral Production and Sales Statistics, monthly.

TABLE 1
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
METALS						
Aluminum metal, primary		569,600	673,043	677,000	689,230 r/	676,000
Antimony concentrate: 3/						
Gross weight		8,860	5,888	7,316	9,100	7,076
Sb content (58% Sb)		5,137	3,415	4,243	5,278	4,104
Chromite, gross weight:						
44% to 48% chromic oxide	thousand tons	1,862	2,279 r/	2,329	2,447	2,261
Less than 44% chromic oxide	do.	3,216 r/	3,883 r/	4,151	4,370	4,360
Total	do.	5,078 r/	6,162 r/	6,480	6,817	6,621
Cobalt:						
Mine output, Co content e/		350	465	435	450	580
Refinery output		247	318	296	306	397
Copper:						
Mine (company output), Cu content		152,595	153,058	164,000	144,263	137,092
Metal:						
Smelter		148,400	163,600	152,300	149,300 r/	140,000
Refined, primary		116,000	130,200	125,600	134,500	126,100
Gold, primary	kilograms	496,846	491,680	465,100	451,300	430,778
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand tons	30,830	33,225	32,965	29,512	33,707
Fe content	do.	19,115	20,600 e/	20,438	18,442	20,900
Metal:						
Pig iron	do.	6,876	6,192	5,650 r/	4,587 r/	4,573
Direct-reduced iron	do.	900	1,120	1,070	1,260 r/	1,530
Ferroalloys, electric arc furnace:						
Chromium ferroalloys	do.	1,478	1,940	2,025	2,155	2,526
Ferromanganese	do.	562	525 e/	542 r/	527 r/	530
Ferrosilicon	do.	87 r/	102	108	106	100
Ferrovanadium e/	do.	1	5	6	6	6
Silicomanganese e/	do.	212 r/	266 r/	265 r/	267 r/	270
Silicon metal	do.	29	34	33	36	34
Steel:						
Crude	do.	7,999	8,311	7,679 r/	6,830 r/	7,019
Stainless		334	439	430	450 r/ e/	436
Lead:						
Concentrate, Pb content		88,613	83,114	84,128	80,191	75,262
Smelter, secondary		32,200	43,000	50,000	55,000	53,000
Manganese:						
Ore and concentrate, gross weight:						
Metallurgical:						
More than 48% manganese	thousand tons	1,845	1,809	1,734	1,876	2,047
45% to 48% manganese	do.	86	84	12	12	302
40% to 45% manganese	do.	118	116	218	235	235
30% to 40% manganese	do.	1,133	1,111	1,049	970	1,029
Total	do.	3,182	3,120	3,013	3,093	3,613
Chemical, 35% to 65% manganese dioxide	do.	58	33	31	29	22
Grand total	do.	3,240	3,153	3,044	3,122	3,635
Metal, electrolytic e/	do.	39	40	40	40	40
Nickel:						
Mine output, concentrate, nickel content e/		33,861	34,830	36,679	36,200	36,616
Metal, electrolytic		27,861 r/	28,830 r/	29,039	28,345 r/	29,616 e/
Platinum-group metals: e/						
Platinum	kilograms	105,440	115,861	116,483	121,304	114,459
Palladium	do.	52,560	55,675	56,608	58,164	55,818
Rhodium	do.	11,200	11,664	11,633	12,752	12,067
Other e/ 4/	do.	19,436	13,404 r/	15,229 r/	24,259 r/	24,426
Total	do.	188,636	196,604 r/	199,953 r/	216,479 r/	206,770
Silver	do.	168,689	144,000 r/	144,482 r/	151,959 r/	144,232
Titanium: e/						
Ilmenite concentrate	thousand tons	2,100	2,240 r/	2,300	1,851 r/	2,000
Rutile concentrate	do.	115	123	130	100 r/	100
Total	do.	2,220 r/	2,360 5/	2,430	1,950 5/	2,100

See footnotes at end of table.

TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity	1996	1997	1998	1999	2000
METALS--Continued					
Titanium--Continued: e/					
Titaniferous slag 6/ thousand tons	1,000	1,100	1,100	1,100	1,120
Uranium oxide	1,706	1,324	1,138	1,084 r/	1,015
Vanadium, vanadium metal content	17,095	16,103	18,954	17,612	18,021
Zinc:					
Concentrate:					
Gross weight e/	142,000	132,000	129,000	129,200 r/	116,100
Zn content	76,853	71,062	69,630	69,733	62,703
Metal, smelter, primary	101,100	108,500	107,400	108,000 r/	116,000
Zirconium concentrate (baddeleyite and zircon)	260,000 e/	265,000	265,000	219,000 r/	253,000
INDUSTRIAL MINERALS					
Aluminosilicates:					
Andalusite	233,728	251,203	236,200	136,900	182,674
Sillimanite	--	--	65	--	--
Asbestos:					
Chrysotile	51,776	49,754	27,195	18,700	18,910
Crocidolite	5,344	232	--	--	--
Total	57,120	49,986	27,195	18,700	18,910
Barite	7,428	2,071	610	2,844 r/	1,628
Calcite	13,749	2,886	2,764	2,800 e/	2,800 e/
Cement, hydraulic, sales thousand tons	9,000	9,797 r/	9,581 r/	9,008 r/	8,991
Clays:					
Attapulgite	14,318	9,349	7,800	7,067	7,337
Bentonite	48,076	75,500	48,382	50,700	85,187
Fire clay	101,452	89,600	143,500	121,000	135,079
Flint clay, raw and calcined	113,645	91,700	82,787	88,600	47,256
Kaolin	191,900	164,400	138,300	122,400	98,897
Brick clay, local sales thousand tons	2,919	4,137	3,518	3,249	--
Diamond, natural:					
Gem e/ thousand carats	4,400	4,500	4,700	4,400	4,745
Industrial e/ do.	5,556	5,586	6,051	5,622	6,060
Total do.	9,956	10,086	10,751	10,022	10,805
Feldspar	53,644	68,100	56,400	59,300	66,774
Fluorspar:					
Acid-grade	202,018	201,000	222,000 r/	203,280 r/	197,855
Ceramic-grade e/	--	4,000	--	--	--
Metallurgical-grade	10,000	2,000	15,000 r/	14,000 r/	14,500
Total	202,018	207,000	237,000 r/	217,280 r/	212,355
Gemstones, semiprecious, tiger's eye kilograms	18,650	64,300	87,200	80,000 e/	80,000 e/
Gypsum, crude	340,688	396,900	485,749	513,760 r/	413,105
Industrial or glass sand (silica) thousand tons	2,173	2,463	2,223	2,170	2,138
Lime do.	1,650	1,585	1,523	1,920	1,351
Magnesite, crude	71,358	76,699	74,300	74,000	74,000 e/
Mica, scrap and ground	1,515	1,423	1,556	1,010	708
Nitrogen, N content of ammonia	769,800	752,400	722,800	784,800	560,200
Perlite	1,300	403	400 e/	400 e/	400 e/
Phosphate rock:					
Gross weight thousand tons	2,655	2,732	2,739	2,957 r/	2,779
Phosphorus pentoxide content e/ do.	1,036	1,066	1,068	1,153 r/	1,083
Pigments, mineral, natural:					
Ochers	484	186	122	118	550
Oxides	159	98	64	98	80
Total	643	284	186	216	630
Salt	253,403	322,442	356,059	365,255	346,447
Sodium sulfate, natural	46,947	49,071	48,613	53,400	49,712
Stone, n.e.s.:					
Dimension:					
Granite and norite 7/	708,700	804,300	669,363	782,000	648,818
Marble 7/	1,696	--	--	--	--
Slate	37,800	11,000	23,547	24,500	24,952

See footnotes at end of table.

TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
INDUSTRIAL MINERALS--Continued						
Stone, n.e.s.--Continued:						
Crushed and broken:						
Limestone and dolomite	thousand tons	22,038	22,214	19,754	19,030	15,881
Nepheline syenite		137,706	114,201	11,500 e/	--	--
Quartzite	thousand tons	8,515	8,500	10,203	8,360	7,965
Shale:						
For cement	do.	338	334	279	304	303
For aggregate and sand	do.	3 r/ 5/	3 r/ 5/	4 r/ 5/	3 r/ 5/	7
Total	do.	3,338	3,334	3,986	2,850	7,661
Aggregate and sand, n.e.s.	do.	20,792	32,971	33,803	29,344	29,118
Sulfur:						
S content of pyrite (53.45%)	do.	184 r/	167 r/	152 r/	141 r/	146
Byproduct:						
Metallurgy e/	do.	19 r/	47 r/	122 r/	126 r/	100
Petroleum	do.	232 r/	256 r/	178 r/	139 r/	202 e/
Total	do.	435	470 r/	452 r/	406 r/	448
Talc and related materials:						
Talc		9,700	12,600	11,300	7,900	5,600
Pyrophyllite (wonderstone)		8,837	10,610	11,500	13,277	11,989
Vermiculite		196,000	211,000	221,300	217,800	208,835
MINERAL FUELS AND RELATED MATERIALS						
Coal (salable product):						
Anthracite	thousand tons	2,465	1,997	2,101	1,930	1,618
Bituminous	do.	202,531	217,272	222,283	221,541	221,272
Total	do.	204,996	219,269	224,384	223,471	222,890
Natural gas	million cubic meters	980	1,756	1,560	2,039	2,088
Petroleum: 8/						
Crude	thousand 42-gallon barrels	--	3,744	6,549	5,493	6,606
Refinery products:						
Liquefied petroleum gases	do.	3,285	3,650 r/	3,650 r/	3,650 r/ e/	3,650 e/
Gasoline	do.	66,795	67,525 r/	67,525 r/	67,000 r/ e/	67,000 e/
Jet fuel	do.	10,220	11,315 r/	12,410 r/	12,000 r/ e/	12,000 e/
Kerosene	do.	6,935	6,205 r/	7,300 r/	7,000 r/ e/	7,000 e/
Distillate fuel oil	do.	49,275	39,785 r/	55,115 r/	55,000 r/ e/	55,000 e/
Residual fuel oil	do.	25,550	19,345 r/	24,090 r/	24,000 r/ e/	24,000 e/
Lubricants (including greases) e/	do.	3,000	3,650 r/	3,650 r/	3,650 r/ e/	3,650 e/
Other e/	do.	7,950	10,585 r/	8,760 r/	8,700 r/ e/	8,700 e/
Total 9/	do.	173,010	162,060 r/	182,500 r/	181,000 r/ e/	181,000 e/

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through September 2001.

2/ Estimated data are rounded to no more than three significant figures; may not add to totals shown.

3/ Data are for the year ending June 30 of that stated.

4/ Difference between total production reported by Minerals Bureau and platinum, palladium, and rhodium supplies (shipments) reported in Johnson and Matthey Annual Platinum Review. Includes ruthenium and iridium production plus excess platinum, palladium, and rhodium inventory.

5/ Reported figure.

6/ Except for about 45,000 metric tons per year of slag derived from titaniferous magnetite by Highveld Steel and Vanadium Corp. Ltd., titaniferous slag is all from the smelting of ilmenite and likely represents most of that mineral's production, for which data are unavailable.

7/ Converted from reported cubic meters using 1 cubic meter=2.7 metric tons.

8/ In addition, Sasol produces about 67 million barrels per year of synthetic liquid petroleum fuels from coal.

9/ Excludes refinery fuel and losses.

TABLE 2
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	BHP Billiton Aluminium South Africa (Pty.) Ltd. (BHP Billiton plc., 100%)	Bayside smelter at Richards Bay	175.
Do.	do.	Hillside smelter at Richards Bay (planned expansion by 2003)	500+ increase to 650.
Andalusite	Rhino Minerals (Pty.) Ltd. [Mircal South Africa (Pty.) Ltd., 100%.	Rhino Mine near Thabazimbi	120.
Do.	do.	Havercroft Mine at Penge, north of Steelpoort	60.
Do.	Samrec Pty. Ltd. of France (private, 100%)	Annesley Mine at Penge, 50 kilometers north of Steelpoort	75.
Do.	do.	Andalusite Refractories Mine at Groot Marico, 60 kilometers west of Rustenburg	12.
Do.	do.	Krugerspost Mine near Lydenburg	50.
Do.	Hoogenoeg Andalusite (Pty.) Ltd.	Hoogenoeg Mine 60 kilometers northeast of Potgietersrust	15.
Antimony	Consolidated Murchison Mine Ltd. [Metorex Pty. Ltd., 34.3%, Crew Development Corp. (Canada), 3.3%]	50 kilometers west of Palabora	7 antimony concentrate, 1,000 kilograms gold byproduct.
Asbestos	Kaapsehoop Asbestos Pty. Ltd.	New Amianthus Mine in Mpumalanga.	NA (chrysotile).
Do.	African Chrysotile Asbestos Ltd.	Msauli Mine near Barberton (closed)	NA (chrysotile).
Do.	Anglo Dutch Exploration & Mining Co. (Pty.) Ltd.	Stella Mine east of Barberton (closed)	NA (chrysotile).
Do.	Griqualand Exploration and Finance Corp.	Kuruman Mine (closed in 1998)	NA (crocidolite).
Cement	Anglo Alpha Ltd. (Holderbank; Anglovaal Industries Ltd.)	Dudfield kiln near Lichtenburg and grinding mill at Roodepoort	1,830.
Do.	do.	Ulco kiln 60 kilometers northwest of Kimberly	1,615.
Do.	Lafarge South Africa Ltd. [Lafarge (France)]	Lichtenburg kiln in North West Province	2,400
Do.	do.	White's kiln	200.
Do.	Natal Portland Cement Co. (Pty.) Ltd. (co-owned by Anglo Alpha, Lafarge, and Pretoria Portland Cement companies)	Simumu plant 125 kilometers southwest of Durban and grinding mills at Durban and Newcastle	1,500.
Do.	Pretoria Portland Cement Co. Ltd. (Barlow Rand Group, 60.3%)	De Hoek, Dwaalboom, Herculese, Jupiter, Slurru, Riebeeck West, and Port Elizabeth kilns	5,500 (combined), clinker.
Chromite	Samancor Ltd. (BHP Billiton plc., 60%, Anglo American plc, 40%)	Eastern Chrome Mines in Steelpoort Valley, Mpumalanga Province; includes Lannex, Groothoek, Jagdlust, Mooihoek, Tweefontein, and Steelpoort mines	2,200 run-of-mine ore.
Do.	do.	Western Chrome Mines in Northern Province; includes Elandsdrift, Mooinooi, Ruighoek, and Waterkloof-Millsell mines	1,800 run-of-mine ore.
Do.	Chromecorp Holdings Ltd. (Xstrata Ag, 100%)	Kroondal Mine east of Rustenburg	1,260 ore; 880 concentrate.
Do.	do.	Wonderkop Mine east of Rustenburg	720 ore; 400 concentrate.
Do.	do.	Chroombronne Mine near Rustenburg	576 ore; 432 concentrate.
Do.	do.	Purity Mine near Rustenburg	360 ore; 252 concentrate.
Do.	Hernic Ferrochrome Pty. Ltd., [South African Chrome and Alloys Ltd.; EL Daniel (Germany); Nittetsu Shoji (Japan)]	Hernic Chrome Mine near Brits, North West Province, and Mooinooi Mine near Rustenburg	NA.
Do.	Bayer Pty. Ltd.	Rustenburg Chrome Mine	NA.
Do.	Lavino South Africa (Pty.) Ltd. (Anglovaal Minerals Ltd., 51%; Middle Witwatersrand, 49%)	Grootboom Mine near Lydenburg	500 ore.
Do.	Dilokong Chrome Mine (Pty.) Ltd. (Mining Corp. Ltd., 100%)	Dilokong Mine near Lydenburg	480 ore.
Do.	Associated Manganese Mines of South Africa Ltd.; (Anglovaal Minerals Ltd., 50.2%; Associated Ore and Metal Corp., 45.2%)	Dwarsrivier Mine	1,000 run-of-mine ore.
Coal	Amcoal Colliery and Industrial Operations Ltd. [Anglo American plc. (52%)]	Eight collieries: Arnot, Bank, Goedehoop, Kriel, New Denmark, New Vaal, SA Coal Estates, and Vryheid Coronation in Mpumalanga and KwaZulu-Natal Provinces	52,000 anthracite and bituminous.
Do.	Ingwe Coal Corp. Ltd. (BHP Billiton Plc, 100%)	Ten collieries in Mpumalanga and KwaZulu-Natal Provinces	59,000 anthracite and bituminous.
Do.	Duiker Mining Ltd., (Glencore International AG, 100%)	Duiker and Tavistock collieries (six mines, include Tweefontein and Spitzkop collieries).	20,000.
Do.	Duvha Opencast Services (Pty.) Ltd. (Rand Mines Ltd., 71%)	Duvha colliery 18 kilometers southeast of Witbank	11,000 bituminous.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Coal--Continued:	Kangra Group Pty. Ltd.	Savamore, Springlake, Taaboschpruit, and Welgedacht collieries	4,300 bituminous and steam.
Do.	Sasol Mining (Pty.) Ltd. (Sasol Limited, 100%)	Sigma colliery and two mines 75 kilometers south of Johannesburg (closed end 1999).	5,500 bituminous.
Do.	do.	Secunda collieries and six mines 75 kilometers south of Witbank	43,000 bituminous.
Do.	Iscor Mining (Iscor Ltd., 100%)	Grootegeluk Mine 120 kilometers north of Thabazimbi	12,000 steam coal, 2,000 coking coal, 450 metallurgical coal.
Do.	do.	Leeuwpan colliery in Mpumalanga Province	1,250 steam coal.
Do.	do.	Durnacol Mine at Dannhauser, 40 kilometers south of Newcastle	530 coking coal.
Do.	do.	Tshikondeni Mine in Venda, about 100 kilometers southeast of Messina	410 coking coal.
Do.	Anglovaal Minerals Ltd. (100%)	Dortsfontein Colliery	700.
Do.	do.	Forzando Colliery	1,350.
Do.	Newcoal [Eyesizwe Coal (Pty.) Ltd., 80%; Anglo Coal, 11%; Ingwe Coal Corp. Ltd., 9%]	Matla, Arnot underground, Glisa, and New Clydesdale collieries	18,000
Do.	Kuyasa Mining (Pty.) Ltd.	Ikhewezi Mine near Delmas	350.
Do.	Gold Fields Coal Ltd	Greenside and New Clydesdale collieries	3,000.
Do.	Anker Holdings B.V. (Netherlands)	Elandsfontein, Golfview, Van Oudshoornstrom, and Woestalleen collieries.	5,000. e/
Do.	Wakefield Coal Division, [Metorex Pty. Ltd., 40.07% (Canada)]	Leeuwfontein and Side collieries in Witbank coalfield	1,300 steam.
Copper	Palabora Mining Co. Ltd. (Rio Tinto plc, 46.4%; Anglo American plc./De Beers, 29%)	Palabora open pit mine and plant at Palabora	130 metal in ore.
Do.	do.	(Switch to underground mining in 2002)	Reduce to 75 metal in ore.
Do.	do.	Smelter at Phalaborwa	140 anodes.
Do.	do.	Refinery at Phalaborwa	125 cathodes.
Do.	O'okiep Copper Co. (Pty.) Ltd. [Metorex (Pty.) Limited, 89%]	Nigramoep copper mine near Nababeep, Northern Cape Province.	15 copper in concentrates.
Do.	do.	O'okiep smelter at Nababeep	42 blister.
Do.	Black Mountain Mineral Development Co. (Pty.) Ltd. (Anglo American plc, 100%)	Black Mountain Mine near Aggeneys, 100 kilometers northeast of O'okiep	5 copper in concentrate.
Do.	Maranda Mining Co. [Metorex (Pty.) Limited, 29.1%]	Maranda zinc-copper mine in Murchison Range in Northern Province	1.6 copper metal.
Diamond thousands	De Beers Consolidated Mines Ltd. (Anglo American plc, 29%)	Finsch Mine 100 kilometers west of Kimberly	2,500. e/
Do. do.	do	Kimberley Mines at Kimberley	800. e/
Do. do.	do.	Koffiefontein Mine 70 kilometers south of Kimberley	200. e/
Do. do.	do.	Marsfontein	500. e/
Do. do.	do.	Namaqualand Mines 50 kilometers north of Port Nolloth	800. e/
Do. do.	do.	The Oaks	120. e/
Do. do.	do.	Premier Mine 70 kilometers east of Pretoria	1,800. e/
Do. do.	do.	Venetia Mine 150 kilometers north of Potgietersrust	5,000. e/
Do. do.	SouthernEra Resources Ltd. (Canada)	Klipspringer Mine near Potgietersrust in Northern Province	1,000.
Do. do.	Benguela Concessions Ltd.	Several marine operations along Namqualand coast. Moonstone mining ship	40.
Do. do.	Trans Hex Group Ltd.	Baken deposit on Orange River, Hondklip Bay, So Ver, Reuning, and Komagass mines and three marine operations off Northern Province	200.
Do. do.	Trivalence Mining Corp. of Canada, (100%)	Palmietgat kimberlite mine	50
Fluorspar	Vergenoeg Mining Co. (Pty.) Ltd. [Metorex Pty. Ltd., 70%; Minerales y Productos Derivados SA (Spain), 30%)]	Vergenoeg Mine 75 kilometers north of Pretoria	125 acid grade fluorspar, 10 metallurgical grade fluorspar.
Do.	Witkop Fluorspar Mine (Pty.) Ltd. [South Africa Land & Exploration Co. (Sallies) (Athlone International (Australia), 100%]	Witkop Mine 250 kilometers west of Johannesburg	140 acid-grade fluorspar (expand to 280 by 2002).

See footnotes at end of table.

TABLE 2--Continued

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Fluorspar--Continued:		Van den Heever Fluorspar Works	Van Den Heever Mine 120 kilometers west of Johannesburg	50 metallurgical grade fluorspar. e/
Gold	tons	AngloGold Ltd. (Anglo American plc, 100%)	Vaal River Operations, includes Great Noligwa (ex-Vaal Reefs Shaft 8), Kopanang (Vaal Reefs #9, and Tau Lekoa (Vaal Reefs #10) underground mines; Vaal River surface operations; and Moab Khotsong development	60 gold.
Do.	do.	do.	Ergo Operations--slimes dam reprocessing	11 gold.
Do.	do.	do.	Free State Operations, includes Bambanani (President Steyn #4), Tshepong (Freegold #2), Matjhabeng (ex-Western Holdings), and Joel, underground mines and Free State surface operations	48 gold.
Do.	do.	do.	West Wits Operations, includes Tau Tona (ex-Western Deeps-East), Savuka (ex-Tau Tona and ex-Western Deeps-East), Savuka (ex-Western Deeps-West), Mponeng (ex-Western Deeps-South) underground mines	42 gold.
Do.	do.	do.	Western Ultra Deep Levels project	12 gold by 2003.
Do.	do.	Gold Fields Ltd.	Beatrix, Driefontein, Kloof, Oryx, St. Helena, and Target mines west and southwest of Johannesburg	125 gold (South African operations only).
Do.	do.	Harmony Gold Mining Co. Ltd.	Free State Operations, shafts include Harmony 2 and 4; Merriespruit 1, 7, and 3; Virginia, Unisel, Masimong 4 and 5; Brand 2, 3, and 5; Central, Saaiplaas and Virginia metallurgical plants; and Central refinery	26.5 gold.
Do.	do.	do.	Deelkraal and Elandsrand mines	20 gold.
Do.	do.	do.	Evander Operations, includes six shafts and Leslie, Kinross, and Winkelhaak metallurgical plants	12.5 gold.
Do.	do.	do.	Randfontein Operations, includes Cooke 1, 2, and 3 shafts and No. 4 and Doornkop shafts and metallurgical plants and Doornkop South Reef development	24.9 gold.
Do.	do.	do.	Lindum open pit operations	(included in Randfontein).
Do.	do.	do.	Kalgold open pit, heap leach, and carbon-in-leach operation at Mafikeng, Northwest Province	3.2 gold.
Do.	do.	Avgold Ltd. (Anglovaal Mining Ltd., 60.1%)	Eastern Transvaal Consolidated Division (Sheba, Fairview, and New Consort Mines) near Klerksdorp	2.8 gold.
Do.	do.	do.	Target Mine (full production by early 2002)	10.9 gold by 2002.
Do.	do.	Durban Roodeport Deep Ltd.	Blyvoorruitzicht and Doornfontein section	6.3 gold.
Do.	do.	do.	Buffelsfontein section	5.5 gold.
Do.	do.	do.	Hartebeestfontein section	15.5 gold.
Do.	do.	do.	Crown section--tailings retreatment	4.1 gold.
Do.	do.	do.	Argonaut Deep project (on hold)	60 million troy ounces.
Do.	do.	Western Areas Ltd. (JCI Gold, 50%; Placer Dome Inc., 50%)	Western Areas	6 gold.
Do.	do.	do.	South Deep project	11.7 gold by 2002.
Do.	do.	Rand Refinery Ltd.	Germiston, Gauteng Province	1,200 refined gold.
Iron and steel:				
Iron ore		Iscor Ltd.	Sishen Mine at Sishen	27,000 ore, to 32,000 by 200
Do.		do.	Thabazimbi Mine at Thabazimbi	2,900 ore.
Do.		Highveld Steel and Vanadium Corp. Ltd. (Anglo American plc, 74%)	Mapochs Mine at Roossenekal, 60 kilometers west of Lydenburg	3,000 titaniferous and vanadiferous magnetite ore.
Do.		Associated Manganese Mines of South Africa Ltd. (Anglovaal Minerals Ltd., 50.2%)	Beeshoek Mine near Postmasburg	4,500 ore.
Ferroalloys 2/		Samancor Chrome Division (BHP Billiton plc, 60%, Anglo American plc, 40%)	Ferrometals plant at Witbank (six furnaces) (two furnaces at 110,000 capacity closed in 1999); F1 and F2 20-megawatt furnaces (80,000 metric tons per year) closed August 2000	450 ferrochromium.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Iron and steel--Continued			
Ferroalloys--Continued: 2/	Samancor Chrome Division (BHP Billiton plc, 60%; Anglo American plc, 40%)	Tubatse Ferrochrome plant at Steelpoort (six furnaces)	340 ferrochromium.
Do.	do.	Middelburg Ferrochrome plant 35 kilometers east of Witbank (three furnaces)	235 ferrochromium.
Do.	do.	Palmiet Ferrochrome plant at Krugersdorp, 30 kilometers west of Johannesburg (three furnaces)	120 ferrochromium.
Do.	do.	Bathlako Ferrochrome plant at Ruighoek, northwest of Rustenburg	20 ferrochromium.
Do.	Chromecorp Holdings Ltd., (Xstrata AG, 100%)	Rustenburg (six furnaces)	400 ferrochromium.
Do.	do.	Lydenburg (four furnaces)	350 ferrochromium.
Do.	do.	Wonderkop (four furnaces)	320 ferrochromium.
Do.	do.	Rustenburg slag retreatment plant	25 ferrochromium.
Do.	do.	Wonderkop slag retreatment plant	20 ferrochromium.
Do.	do.	Silicon Technology plant at Ballengeich, KZN	55 ferrosilicon.
Do.	Samancor and Xstrata Joint Venture (BHP Billiton plc, 50%; Xstrata AG, 50%)	Wonderkop furnace (mid-2001 start up)	180 ferrochromium.
Do.	South African Chrome and Alloys Ltd.	Elandsdift and Horizon Chromite Mines; proposed new ferrochrome smelter planned	150 ferrochromium. (150-170 ferrochromium).
Do.	Hernic Ferrochrome Pty. Ltd. [South African Chrome and Alloys Ltd; EL Daniel (Germany); Nittetsu Shoji (Japan)]	Plant near Brits (two furnaces)	260 ferrochromium.
Do.	Feralloys Ltd. (Associated Manganese Mines of South Africa Ltd., 100%)	Machadadorp plant (three furnaces) 80 kilometers east of Middelburg	150 ferrochromium, 175 by 2000.
Do.	Cato Ridge Alloys Ltd. (Associated Manganese Mines of South Africa Ltd., 50%; Mizushima Ferroalloy Co. Ltd., 40%; Sumitomo Corp., 10%)	Cato Ridge 75 kilometers west of Durban	245 ferromanganese.
Do.	Samancor Manganese Division, (BHP Billiton plc, 54.6%; Anglo American plc, 28.9%; private, 16.5%)	Metalloys Ltd. plant at Meyerton (nine furnaces), 50 kilometers south of Johannesburg; can switch between FeMn and SiMn	530 high-carbon ferromanganese, 200 silicomanganese.
Do.	Advalloy (Pty.) Ltd. (BHP Billiton/Samancor, 50%; Japan Metals & Chemicals Co., 35%; Mitsui & Co. Ltd., 15%)	Furnace at Samancor's Meyerton Plant	75 low-carbon and high carbon ferromanganese.
Do.	Manganese Metal Co. (Pty.) Ltd. (Samancor Ltd.)	Plants at Krugersdorp and Nelspruit	44 electrolytic manganese.
Do.	Transalloys Division (Highveld Steel and Vanadium Corp. Ltd., 100%)	Witbank	50 medium-carbon ferromanganese.
Do.	do.	do.	175 silicomanganese.
Do. tons	ASA Metals (Pty.) Ltd. (Eastern Asia Metal Investment Co. Ltd., 60%; Northern Province Development Corp., 40%)	Plant near Pietersburg, Northern Province (associated with Dilokong Chrome)	50 ferrochrome.
Do.	Rand Carbide Division (Highveld Steel and Vanadium Corp. Ltd., 100%)	Plant at Witbank, Mpumalanga Province	58 ferrosilicon.
Do. tons	Vametco Minerals Corp. (Strategic Minerals Corp., USA, 100%)	Smelter near Brits	5,250 ferrovanadium.
Steel	Iscor Ltd.	Vanderbijlpark Works	3,200 flat products.
Do.	do.	Newcastle Works	2,000 profile products.
Do.	do.	Vereeniging Works	450 specialty steels. e/
Do.	Highveld Steel and Vanadium Corp. Ltd. (Anglo American plc, 74%)	Witbank	1,000 cast billets, blocks, and slabs.
Do.	Saldanha Steel (Pty.) Ltd. (Iscor Ltd., 50%; Industrial Development Corp., 50%)	Hot-rolled steel coil plant at Saldanha Bay	1,200.
Do.	Columbus Stainless (Samancor, 33.3%; Highveld Steel and Vanadium Corp. Ltd., 33.3%; Industrial Development Corp., 33.3%)	Stainless steel plant at Middelburg	500.
Do.	Scaw Metals Division, Anglo Operations Ltd.	Germiston plant, Johannesburg	500 speciality castings and rolled products.
Do.	Duferco Steel Processing Ltd.	Cold-rolled slab steel at Saldanha Bay	400.
Do.	Davsteel Division, Cape Gate Pty. Ltd.	Vanderbijlpark plant at Gauteng	400 rebar, wire rod, and other shapes.
Do.	Cape Town Iron & Steel Works (Pty.) Ltd. (CISCO)	Kuilsrivier plant at Cape Town	180 rebar.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Manganese	Associated Manganese Mines of South Africa Ltd., (Avmin Ltd., 50.2%)	Gloria and N'Chwaning Mines near Black Rock, 70 kilometers north of Sishen	1,500 ore.
Do.	Samancor Ltd. (BHP Billiton plc, 60%; Anglo American plc, 40%).	Mamatwan open pit mine and ore sintering plant near Hotazel	2,200 ore, of which 1,100 sintered ore.
Do.	do	Wessels underground mine near Hotazel	1,200 ore.
Do.	Manganese Metal Co. Pty. Ltd. (Samancor Ltd., 100%)	Electrolytic plant, Nelspruit, Mpumalanga	26 manganese metal.
Do.	do.	Electrolytic plant, Krugersdorp, Gauteng	18 manganese metal.
Do.	Metmin (Metorex Pty. Ltd., 100%)	Open pit mine in North West Province (used as catalyst for extracting uranium from gold).	24 manganese dioxide.
Nickel Do	Nkomati Joint Venture (Anglovaal Mining Ltd., 75%; Anglo American plc, 25%)	Nkomati Mine in Mpumalanga Province	15 nickel in concentrate.
Petroleum, thousand crude 42-gallon barrels	Soeker (Government, 100%)	Oribi Field 140 kilometers southwest offshore from Mossel Bay	9.1.
Do. do.	do	Oryx Field	1.8. e/
Do. do.	do	Sable Field (in development in 2000-2001)	14.6.
Do. do.	Mossgas [Government (through Central Energy Fund), 100%]	Nine wells in Mossel Bay	3.5.
Do. do.	Shell and BP Refineries Pty. Ltd. (Shell South Africa, 50%; BP p.l.c., 50%)	Sanref refinery in Durban	60 crude.
Do. do.	Caltex Oil SA Pty. Ltd. (private, 100%)	Refinery in Cape Town	41 crude.
Do. do.	National Petroleum Refiners of South Arfica Pty. Ltd. (Sasol Ltd., Total SA)	Natref Refinery in Secunda, 100 kilometers southeast of Johannesburg	32 crude.
Do. do.	Engen Ltd., 62%	Engen Refinery in Durban	38 crude.
Phosphate	Phosphate Development Corp. Ltd. (Foskor Ltd.) (Industrial Development Corp., 100%)	Foskor Mine and plant at Phalaborwa	2,900 phosphate rock. 3/
Platinum-group metals kilograms	Anglo American Platinum Corp. Ltd. (Anglo Platinum) (Anglo American plc, 100%)	Rustenburg section near Rustenburg, Rustenburg underground and open pit mines (New Waterval UG2 mine by 2002); adding 12,285 kilograms per year platinum capacity by 2002	24,000 platinum metal, 10,260 palladium metal, 1,650 rhodium metal.
Do. do.	do.	Rustenburg mill	9,000,000 tons per year ore.
Do. do.	do.	Union section, 50 kilometers south of Thabazimbi	9,850 platinum metal, 4,540 palladium metal, 1,470 rhodium metal.
Do. do.	do.	Union mill	4,000,000 tons per year ore.
Do. do.	do.	Amandelbult section, 50 kilometers south of Thabazimbi iron ore mines	17,700 platinum metal, 8,150 palladium metal, 6,500 rhodium metal.
Do. do.	do.	Amandelbult mill	6,000,000 tons per year ore.
Do. do.	do.	Lebowa Platinum (Atok) Mine, 70 kilometers east of Potgietersrust	2,520 platinum metal, 1,100 palladium metal, 150 rhodium metal.
Do. do.	do.	Lebowa Platinum mill	1,000,000 tons per year ore.
Do. do.	do.	Potgietersrust Platinum Mine (30 million metric tons per year low grade ore mined, most of which is stockpiled for future use)	5,160 platinum metal, 5,500 palladium metal, 350 rhodium metal.
Do. do.	do.	Potgietersrust Platinum mill	3,100,000 tons per year ore.
Do. do.	do.	Bafokeng Rasimone Mine in Northern Province opening in 2000, full capacity by 2002	7,776 platinum-group metals
Do. do.	do.	Bafokeng Rasimone mill	2,400,000 tons per year ore.
Do. do.	do.	Waterval Mine	12,285 platinum-group metal
Do. do.	do.	Total Amplats mill capacity	23,800,000 tons per year ore.
Do. do.	do.	Waterval mill	4,800,000 tons per year ore.
Do. do.	do.	Waterval smelter	50 converter matte.
Do. do.	do.	Rustenburg Base Metals Refiners Refinery	25 nickel plus refined copper and cobalt and precious metals concentrates.
Do. do.	do.	Precious Metals Refinery (total Amplats capacity)	70,000 platinum metal, 34,000 palladium metal, 6,500 rhodium metal.
Do. do.	Anglo Platinum and African Rainbow Minerals	Maandagshoek Mine (full capacity by 2003)	5,000 platinum metal.
Do. do.	do.	Maandagshoek mill (to treat UG2 ore)	2,400,000 tons per year ore.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Platinum-group metals--Continued: kilograms	Impala Platinum Ltd. [Impala Platinum Holdings Ltd. (Implats), 100%]	13 mine shafts, concentrator, and smelter near Rustenburg, North West Province	15,000,000 tons per year ore.
Do. do.	do.	Enhanced Precious Metals Refinery near Springs, Gauteng Province	62,200 platinum, 18,000 palladium, 4,600 rhodium.
Do. do.	do.	Reopening Crocodile River Mine in 2001	1,555 platinum; 930 other platinum-group metals.
Do. do.	do.	Platexco properties, including Winnaarshoek Deposit adjacent to Implats Clapham, Forrest Hill and Dreikop properties, plus Platexco Mokopane and Septre properties	6,220 platinum-group metals
Do. do.	Lonmin Platinum (Lonmin Plc., 73%; Impala Platinum Holdings Ltd., 27%)	3 mines (Eastern Platinum, Karee, and Western Platinum) near Rustenburg	37,324 platinum-group metals in concentrates; 10 million tons per year ore.
Do. do.	do	Smelter	Matte, 6,000 grams per ton platinum-group metals.
Do. do.	do.	Base Metals Refinery	Copper and nickel sulfate, and platinum-group metal concentrates.
Do. do.	do.	Precious Metals Refinery at Western Platinum, 20 kilometers east of Rustenburg	20,600 platinum, 9,330 palladium, 2,800 rhodium.
Do. do.	Northam Platinum Ltd. (Mvelaphanda Platinum, 22.5%; Anglo Platinum, 20%)	Northam Mine 20 kilometers south of Thabazimbi	13,000 platinum.
Do. do.	do.	Northam mill (treats Merensky ore)	1,800,000 tons per year ore.
Do. do.	do.	New mill in 2001 (to treat UG2 ore)	900 ore.
Do. do.	do.	Northam Refinery	5,910 platinum.
Do. do.	Kroondal Platinum Mines [Aquarius Platinum Ltd., (Australia), 45%; Implats, 15%]	Kroondal Minel, 10 kilometers east of Rustenburg (opening in 2000)	3,110 platinum, 1,555 palladium, 467 rhodium.
Do. do.	do.	Kroondal mill	1,200,000 tons per year ore
Do. do.	Aquarius Platinum Ltd. (Australia), (Implats, 25%)	Marikana Mine 20 kilometers southeast of Rustenburg (feasibility study in 2000)	4.665 platinum planned.
Do. do.	do.	Marikana mill	1,540,000 tons per year ore
Do. do.	do.	Everest South deposit feasibility study in 2001	5,440 platinum-group metals planned.
Do. do.	Messina Holdings Ltd. (SouthernEra Resources Ltd., 70.4%) (purchased from Implats in 1999)	Messina platinum deposit near Klipspringer diamond mine, Northern Province, 2003 startup	2,176 platinum, 1,681 palladium, 247 rhodium.
Do. do.	East Daggafontein Ltd. (Mvelaphanda Platinum, 100%)	Tailings dump retreatment operation at East Daggafontein	NA.
Pyrophyllite	Alpha Ltd.	Idwala Industrial Minerals plant and Witpoort Quarry	NA.
	Wonderstone Ltd., (The Associated Ore & Metals Corp. Ltd.)	Pyrophylite (wonderstone) Mine in North West Province	NA.
Do.	G&W Base and Industrial Minerals Pty. Ltd.	Masala Mine at Mpumalanga	NA.
Salt	Salt is mined/extracted from 4 seawater and 50 salt-pan brine operations	Operations are distributed throughout the country with the greatest concentration within a major inland saltpan around the border of the Free State and Northern Cape Provinces	400.
Silicon	Silicon Smelters (Pechiney, 77%, Samancor, 23%)	Near Pietersburg, Northern Province (three submerged arc furnaces)	40 silicon.
Synthetic fuels million 42-gallon barrels	Sasol Ltd. (Government, 100%)	Coal-to-oil plant at Secunda and a coal-to-petrochemical plant at Sasolburg	54.8.
Do. do.	Mossgas [Government (through Central Energy Fund), 100%]	Natural-gas-to-petroleum products plant at Mossel Bay	16.4.
Titanium:			
Titanium concentrates	Richards Bay Minerals trading for Tisands (Pty.) Ltd. and Richards Bay Iron and Titanium (Pty.) Ltd. (Rio Tinto plc, 50%; BHP Billiton plc, 50%)	Opencast operations near Richards Bay	1,280 ilmenite concentrate, 125 rutile concentrate. e/
Do.	Namakwa Sands Ltd. (Anglo Operations Ltd, a subsidiary of Anglo American plc, 100%)	Opencast mine near Brand-se-Baai and mineral separation plant at Koekenaap, 300 kilometers northwest of Cape Town	540 ilmenite concentrate, 42 rutile concentrate.

See footnotes at end of table.

TABLE 2--Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY 1/

(Thousand metric tons unless otherwise specified)

Major commodities		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Titanium slag		Richards Bay Iron and Titanium (Pty.) Ltd./Richards Bay Minerals (Rio Tinto plc)	Smelter at Richards Bay	1,000 titania slag.
Do.		Namakwa Sands Ltd. (Anglo Operations Ltd., a subsidiary of Anglo American plc, 100%)	Smelter at Vredenberg, Saldanha Bay area	230 titania slag (by 2000), 120 pig iron.
Do.		Highveld Steel and Vanadium Corp. Ltd.	Steel plant at Witbank	48 titania slag. e/
Uranium	tons	AngloGold Ltd. (Anglo American plc, 60%; De Beers, 40%)	Vaal River operations near Klerksdorp	2,000 uranium oxide (900 at 2000 output). e/
Do.	do.	Durban Roodepoort Deep Ltd.	Hartebeestfontein Mine and plant 5 silometers southeast of Klerksdorp	400 uranium oxide (less than 200 at 2000 output). e/
Do.	do.	Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	160 uranium oxide. e/
Vanadium	do.	Highveld Vanadium and Chemicals (Anglo American plc through Highveld Steel and Vanadium Corp. Ltd.)	Mapochs Mine near Lydenburg	25,000 vanadium pentoxide. e/
Do.	do.	do.	Highveld steel plant in Witbank	17,000 vanadium pentoxide.
Do.	do.	do.	Highveld Vantra plant in Witbank	8,000 vanadium pentoxide.
Do.	do.	Vametco Minerals Corp. (Strategic Minerals Corp., USA, 100%)	Krokodilkraal Mine and plant near Brits	5,000 vanadium pentoxide. e/
Do.	do.	Transvaal Alloys Pty. Ltd., (Highveld Steel and Vanadium Corp., 100%)	Wapadskloof Mine and plant 60 kilometers northeast of Middelburg	2,250 vanadium pentoxide. e/
Do.	do.	Vanadium Technology (Pty.) Ltd., [Xstrata AG (nee Sudelektra Holding AG), Switzerland, 100%]	Kennedy's Vale (ex-Vansa Vanadium) Mine and plant near Lydenburg	5,900 vanadium pentoxide, 1,500 ferrovanadium.
Do.	do.	Rhombus Vanadium Holdings Ltd. (Xstrata AG, 100%)	Ba-Mogopa Mine and Usko plant	13,500 vanadium.
Vermiculite		Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	230 concentrate. e/
Do.		Natkruit Vermiculite Mine Pty. Ltd., (Verimex Trading Pty. Ltd.)	Mine near Soutpansberg, Northern Province	22 concentrate, (closed March 1999).
Zinc		Zinc Corp. of South Africa Ltd. (Zincor) (Iscor Ltd., 100%)	Struisbult Springs zinc refinery at Springs, southeast of Johannesburg	120 zinc.
Do.		Black Mountain Mineral Development Co. (Pty.) Ltd. (Anglo American plc, 100%)	Black Mountain Mine near Aggeneys, 100 kilometers northeast of Okiep	26 zinc in concentrate.
Do.		Maranda Mining Co. (Pty.) Limited (Metorex Ltd. 29.1%)	Maranda zinc-copper mine in Murchison Range in Northern Province	15 zinc metal in concentrates, 6 copper metal in concentrates.
Do.		Pering Mine (Pty.) Ltd. (BHP Billiton plc., 100%)	Pering Mine in Northern Cape Province (phased closure 1999-2001)	27 zinc in concentrate, 6 lead in concentrate.
Zirconium		Tisand (Pty.) Ltd./Richards Bay Minerals	Opencast mines near Richards Bay	300 zircon concentrate.
Do.		Namakwa Sands Ltd. (Anglo Operations Ltd, a subsidiary of Anglo American plc, 100%)	Opencast mine near Brand-se-Baai and mineral separation plant at Koekenaap	140 zircon concentrate.
Do.		Palabora Mining Co. Ltd.	Palabora Mine and plant at Palabora	14 baddeleyite. e/
Do.		do.	Zirconium basic sulfate plant at Palabora	8 zirconium basic sulfate (1999).
Do.		Phosphate Development Corp. Ltd. (Foskor Ltd.) (Industrial Development Corp., 100%)	Plant at Palabora	3 baddeleyite. e/
Do.		do.	Fused zirconia plant	6 synthetic zirconia.

e/ Estimated. NA Not available.

1/ Based on information available, as of October 2001.

2/ Depending on market demand, furnace capacity can switch between ferrochromium and ferromanganese.

3/ Most of Foskor's phosphate output is from phosphate concentrates supplied by the neighboring Palabora copper mine.

TABLE 3
SOUTH AFRICA: RESERVE BASE OF MAJOR MINERALS IN 2000 1/

(Million metric tons unless otherwise specified)

Commodity		Reserve base
Andalusite 2/		50.8
Antimony	thousand tons	250
Chromium, ore		3,100
Coal, recoverable		34,980
Cobalt 3/	thousand tons	15
Copper		13
Diamond 4/	million carats	1,127
Fluorspar		36
Gold	thousand tons	35.9
Iron ore, Fe content		1,500
Lead		3
Manganese		4,000
Natural gas	billion cubic meters	85
Nickel 3/		11.8
Petroleum	million barrels	29.4
Phosphate rock, concentrates		2,500
Platinum-group metals	thousand tons	62.8
Silver	do.	10
Titanium		146
Uranium 5/	thousand tons	218.3
Vanadium		12
Vermiculite		80
Zinc		15
Zirconium		14.3

1/ Metallic minerals are contained metal.

2/ Includes the aluminosilicate, sillimanite.

3/ Minerals Bureau estimates as of December 31, 1997.

4/ De Beers reserves and resource data only.

5/ Recoverable at a cost of less than $80 per kilogram.

Sources: Chamber of Mines Online Statistical Tables 1999, accessed at URL http://www.bullion.org.za/bulza/publications/Stats/MinRes.pdf. Minerals Bureau estimates as of December 31, 1999. U.S. Energy Information Administration, Country Analysis Briefs, South Africa, December 2000, accessed at URL http://www.eia.doe.gov/emeu/cabs/safrica.html.

THE MINERAL INDUSTRY OF

SUDAN

By Philip M. Mobbs

In 1999 (the last year for which data were available), the gross domestic product for this nation of 29 million was estimated to be $10.9 billion.[1] Mineral production traditionally has made a negligible contribution to Sudan's economy. Initiation of commercial gold production in 1991 and production of crude oil, which significantly increased in 1999, however, cemented the mineral sector's influence on the national economy. Other mineral commodities produced in Sudan included asbestos, cement, chromite, gravel, gypsum, limestone, marble, mica, refined petroleum products, salt, and construction sand.

Sudan continued to carry a negative trade balance in 1999, which contributed to its large foreign debt. Total exports were estimated to be $780 million in 1999 compared with $596 million in 1998. Total imports were estimated to be $1,412 million in 1999 compared with $1,925 million in 1998 (Sundararajan and others, 1998, p. 9; Zavadjil and others, 2000, p. 29-31). In 1999, Sudan began to export and ceased to import crude oil, which resulted in the first decrease in the trade deficit since 1994. In 2000, Sudan ended importation of refined petroleum products, and the first petroleum products tanker, which carried 20,000 metric tons of Sudanese benzene, departed the terminal at Marsa al Bashayir near Port Sudan in June (Herald, 2000).

In recent years as gold prices have declined, increased gold exports have only maintained income from that sector (about $50 million per year since 1995). The effect that the income received from gold exports made on the national economy was diluted after the exportation of crude oil began in September 1999 when the Government began to accrue about $1 million per day from the petroleum sector. Oil exports were viewed as the means to reduce the trade deficit and to increase funds earmarked for development.

The Federal Government maintained jurisdiction over mineral operations. Mineral sector investments were subject to the Investment Encouragement Act for 1996. Exploration and production of oil and natural gas also were covered under the Petroleum Wealth Act, 1998. Exploration and production-sharing agreements (EPSA) formed the basis for all petroleum and natural gas contracts.

The United Nations imposed sanctions on Sudan in 1996, but enforcement has been sporadic (United Nations, 1996; Edith M. Lederer, April 13, 2001, U.S. says Sudan must end terrorist sanctuary before UN sanctions are lifted, accessed April 14, 2001, at URL http://www.sudan.net/news/posted/2078.html). Since November 1997, Sudan also has been subject to economic sanctions by the United States. The sanctions, which were codified in the Code of Federal Regulations title 31, part 538, prohibited investment by U.S. businesses in Sudan. On February 14, 2000, the Canadian Government released the results of a 1999 investigation into allegations that Canadian oil company operations in Sudan contributed to the escalation of the 17-year-old civil war and to associated increased human rights abuse and slavery (Harker, 2000). On the basis of the report, the Canadian Government announced that it would continue its policy of dialogue with the Government of Sudan and would not impose sanctions on Talisman Energy Inc. (Talisman Energy Inc., 2000). On February 16, the U.S. Department of the Treasury announced that U.S. economic sanctions against Sudan had been extended to Greater Nile Petroleum Operating Co. (GNPOC), and to Sudapet Ltd. of Sudan, but not to the international corporate owners of GNPOC [China National Petroleum Corp. (CNPC) (40% equity interest); Petronas Carigali Overseas Shd. Bhd. of Malaysia (30%); and State Petroleum Corp., which was a subsidiary of Talisman Energy Inc. of Canada (25%)] (U.S. Department of the Treasury, 2000).

In 2000, publicly owned international oil companies publicized community development projects and humanitarian relief undertaken in Sudan as increasingly intense allegations of Government-abetted atrocities hit the newsstands, thus raising awareness of the longstanding civil war (1955-72 and 1983-present). Criticism was focused on the oil industry (Amnesty International, 2000, p. 2-16, 18-20; Christian Aid, 2000, p. 1-3, 6-11, 14-34; Sheppard and Manhas, 2000). Mineral development, especially oil revenues, had become an acknowledged factor in the civil war (Harker, 2000, p. 14).

Mineral commodity production was small. Sudan was relatively unexplored compared with other countries, and the civil war limited exploration and development. Much of the country's solid minerals activity was located northwest of Port Sudan in the Ariab-Abra'at area, at Hofrat En-Nahas along the Central African Republic border, in the Ingessana Hills along the Ethiopian frontier, and in the Red Sea Hills along Sudan's coast. Oil production was in southern Sudan.

For $40 million, the Lafarge Group of France and Dal Group of Sudan acquired Atbara Cement Co. Ltd., which operated a 360,000-metric-ton-per-year-capacity cement plant at Atbara. The Lafarge-Dal joint venture proposed to invest an additional $170 million to increase production capacity to 1.2 million metric tons per year (Indian Ocean Newsletter, 2000). The state-owned Nile Cement Co. operated a plant at Rabak.

Chromite was mined in the Ingessana Hills. At the end of 1999, Billiton Plc of the United Kingdom ended its copper exploration program in the Hofrat En-Nahas area.

In July, Cie. Française de Mines et Métaux, which was a subsidiary of Cie. Général des Matèrials Nucleaires, acquired 40% equity interest in the Ariab Mining Co. from Cie. Minière Or, which was a subsidiary of Bureau de Recherches Géologiques et Minières (BRGM). BRGM had retained partial ownership interest of Ariab Mining in 1999 when the LaSource Compagnie Minière SAS broke up. Ariab Mining mined the Adassedakh, the Baderuk, and the Hadal Auatib deposits and was exploring for copper and gold near its mine at Ariab. Ariab Mining had initiated gold exploration in the Nubian Desert during 1999. Artisanal gold miners operated in the Fazugli and the Kapoeta areas. Several Chinese companies reportedly held interests in gold mining joint ventures in Sudan (Scott, 2000).

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[1] Where necessary, values have been converted from Sudanese Dinars to U.S. dollars at the rate of D256=US$1.00 for 2000 and D160=US$1.00 for 1999. The Sudanese Dinar (D) replaced the Sudanese Pound (S£) on March 1, 1999.

On blocks 1 and 2 north of Bentiu in the Muglad Basin, GNPOC continued to drill wells and to produce crude petroleum in El Harr, El Nar, El Toor, the Greater Heglig, the Toma South, and the Unity Fields. In 2000, crude oil production from GNPOC increased to about 185,000 barrels per day (bbl/d) from about 47,000 bbl/d in 1999 and 5,000 bbl/d in 1998. In October, OGP Technical Services (a subsidiary of Petronas) began planning a 2-year 50,000-bbl/d expansion of the GNPOC production with the development of two new oilfields, which included the Munga prospect (Iran Daily, October 19, 2000, Economic features—Petronas wins Sudan deal, accessed October 23, 2000, at URL http://www.iran-daily.com/3).

On block 3 northwest of Malakal in the Melut Basin, Gulf Petroleum (Sudan) Ltd. [a joint venture of Qatar Petroleum Co. (60%), Concorp International Ltd. of Sudan (20%), and Sudapet Ltd. (20%)] was producing about 5,000 bbl/d during the dry season (December-May) from the three-well Adar-Yale Field. In March, the joint venture of Melut Petroleum Co. Ltd. (46% equity interest), Gulf Petroleum (Sudan) (46%), and Sudapet (8%) was formed to explore the rest of Gulf Petroleum (Sudan)'s concession area in the Melut Basin. Melut Petroleum withdrew from the venture when incessant coverage of the Sudan civil war adversely affected the availability of funding for work in Sudan (Fosters Resources Ltd., 2001). The Government subsequent issued a new EPSA to a consortium of Gulf Petroleum (Sudan) (46% equity interest), CNPC (23%), Thani Co. of the United Arab Emirates (23%), and Sudapet (8%).

On block 5A, the partnership of International Petroleum Corp. Sudan Ltd. (40.4% equity interest in the partnership), which was an affiliate of Lundin Oil AB of Sweden; Petronas (28.5%); OMV (Sudan) Exploration GmbH of Austria (26.1%); and Sudapet (5%) built a 75-kilometer (km) all-weather road from the riverside base camp at Rubkona to the Thar Jath and the Jarayan well sites. Northeast of Muglad, CNPC was exploring Block 6, which contained the 2,000-bbl/d Abu Ghabra, the Sharaf, and the Tabaldi Fields. TotalFinaElf S.A. retained the rights to block 5 north of Juba; operations had been suspended in 1985 because of the civil war. In July, the Government opened a 50,000-bbl/d-capacity petroleum refinery about 70 km north of Khartoum. Other petroleum refining operations in Sudan included a 21,700-bbl/d-capacity facility at Port Sudan, a 10,000-bbl/d-capacity topping plant near El Obeid, and a 2,000-bbl/d-capacity topping plant at Abu Ghabra (Arab Petroleum Research Center, 2000, p. 423). With the output from the new refinery, Sudan produced sufficient petroleum products to meet domestic demand and exported surplus refined petroleum products.

In 2000, Sudan received $10 million from the Organization of Petroleum Exporting Countries Fund for International Development to rehabilitate the diesel-fired electricity generating plant at Khashm el Girba and sections of the national electricity distribution network. The poor condition of local infrastructure continued to plague mineral operations. Roads were the primary means of transportation. In the south, many roads were passable only during the dry season. The 4,800-km railway and associated rolling stock were in poor condition, but the Government of Iran proposed to assist Sudan's Railway Co. with railcar maintenance, railway development, and traffic signals. The Government of Sudan began a study of extending its rail network into the Central African Republic, Chad, and Ethiopia. The 250,000-bbl/d-capacity pipeline from the Heglig and the Unity Fields to Marsa al Bashayir was a target for rebels and was bombed in September and November 1999 and January 2000. After each incident, the resultant pipeline damage was repaired within a couple of days.

The Government has partnered with international companies to develop the gold and petroleum sectors. Crude oil exports and production from the new oil refinery have freed funds previously dedicated to importing crude and refined petroleum. Applied to development or payment of international debt, the oil money could revive the national economy that has been hampered by the shortage of hard currency. Locally produced asphalt would permit the upgrading of the road network. Refined oil products could be used to produce electrical power. With the existing state of awareness of the civil war, diverting oil profits exclusively to the military sector and neglecting domestic development would not be tolerated by much of the international nongovernmental community.

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TABLE 1

SUDAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
Cement, hydraulic		380,000	291,000	206,000 r/ 3/	267,000 r/ 3/	300,000
Chromite, mine output, gross weight 4/		12,000	30,500	20,000	10,000	10,000
Gold, mine output, Au content 5/	kilograms	4,500	4,554 r/ 3/	5,653 r/ 3/	6,000	6,000
Petroleum:						
Crude (including lease condensate)	thousand 42-gallon barrels	1,000	2,000	1,200	19,000 r/	69,000
Refinery products	do.	7,000	6,000 r/	6,000 r/	8,000 r/	15,000
Salt		50,000	50,000	45,000	50,000	50,000

r/ Revised.

1/ Includes data available through April 1, 2001.

2/ In addition to the commodities listed, the following are presumably produced although available information is inadequate to estimate output: clay and/or shale for cement manufacture (normally about 0.4 metric ton of clay and/or shale per metric ton of finished cement); gypsum for cement manufacture (about 0.04 metric ton per metric ton of finished cement) and plaster; limestone for cement manufacture (normally at least 1.25 metric tons per metric ton of finished cement), agriculture, lime manufacture, and construction aggregate and fill; and other construction materials (clays, sand and gravel, stone, et al. for local use, and marble for export).

3/ Reported figure.

4/ Presumed to be ores and concentrates with an estimated average grade of about 48% chromic oxide.

5/ Does not include artisanal output.

THE MINERAL INDUSTRY OF

SWAZILAND

By George J. Coakley

Mining has been an important part of the history of Swaziland and a small but important factor in its present economy. Swaziland contains the world's oldest known mine at the Lion Cavern site (also known as Bomvu Ridge) in the Ngwenya Mountains where carbon-14 dating studies estimated the date of earliest mining of mining of hematite (libomvu) and specularite, which were extracted for cosmetic and ritual uses, from 43,000 B.C. to 41,000 B.C. These ores could have been mined until at least 23,000 B.C. (Swaziland National Trust Commission, [undated], Mines of Malolotja—Iron mines, accessed April 1, 2001, at URL http://www.sntc.org.sz/cultural/ironmine.html).

In fiscal year 1999-2000, mining and quarrying generated revenues of about $19.4 million[1]; these revenues were estimated to equal 1.3% of the kingdom's gross domestic product, which was $1.49 billion. Mining and quarrying revenues for fiscal year 1999-2000 were comprised of asbestos ($9.3 million), coal ($8.5 million), and crushed stone ($1.6 million) (Central Bank of Swaziland, [2001], Annual report 99-00, accessed April 27, 2001, at URL http://www.centralbank.sz/report2000/ar2000_04.html). Fewer than 1,000 Swazi's were employed in the mining sector. An estimated 1,000 Swazis processed timber that was exported to mines in South Africa, and 10,000 to 15,000 Swazis were employed in South African mines. Wage repatriation from miners in South Africa contributed to the Swazi economy; the collapse of international gold prices and subsequent downsizing of the South African gold mining labor force, however, resulted in layoffs of a number of Swazi miners and reduction in miner remittances back to Swaziland. Asbestos, coal, and crushed stone remained the country's main mining products (table 1). Diamond mining ceased in 1996. Small-scale gold mining has taken place in the past within an extension of South Africa's well-known Barberton greenstone belt into Swaziland; no gold was officially being produced. Swaziland Greenstone Quarry, which was a Taiwanese company, was examining the potential for developing a green chert operation in the Malolotja Nature Reserve in the Hhohho region.

Government Policies and Legislation

In 1998, the Investment Promotion Bill of 1997 became law. The legislation, which is part of the Swazi economic and social reform agenda, was developed to promote local and foreign investment in Swaziland. The Swaziland Investment Promotion Authority, which is a one-stop service center for investors, opened in 1999. In October 2000, the Government announced new tax incentives to attract new foreign investment. The new provisions included a 10-year cut in corporate tax from 37.5 % to 10% for eligible "development" companies and a 10-year exemption from withholding tax on dividends. Mbendi Information Services (October 23, 2000, Swaziland—Mining, accessed April 2, 2001, at URL http://www.mbendi.co.za/indy/ming/af/sw/p0005.htm) reported that China provided a small grant to the Government in 1999 to establish a new mining policy for Swaziland. In an overview of minerals policy and legislation in Swaziland, Mbendi described the following: "There is a fundamental distinction in the constitutional law of Swaziland between the State and its Government on the one hand and on the other the 'Swazi Nation' and the King (the Ngwenyama). By constitution, minerals are vested in the Ngwenyama in trust for the Swazi Nation. The Ngwenyama grants mineral rights after consultation with a Minerals Committee. This committee is appointed by the Ngwenyama on advice by his advisors in accordance with the Swazi law and custom. The conditions and terms of mineral rights issued are negotiated and approved by the Ngwenyama."

Commodity Review

Asbestos.—Production of chrysotile asbestos from the Bulembe Mine, which was one of the world's largest asbestos mines, decreased by 17% from 1998 to 1999. The mine which employed about 1,000 workers, was given a 5-year grace before it had to close in early 1999, when the European Union agreed to delay a ban on asbestos products based on proven health hazards (African National Congress, January 5, 1999, Swazi asbestos mine given five years grace before closure, accessed April 2, 2001, at URL http://www.anc.org.za/anc/newsbrief/1999/news0105). Following similar actions by South African asbestos miners, a group of 450 former asbestos miners who suffer from asbestos-related lung disease announced in September 2000 plans to file suit against the British firm of Turner and Newall, which operated an asbestos mine in northwestern Swaziland in the early 1980's.

Coal.—The Maloma Mine, which was the sole coal producer, switched from open pit to underground operations during 1999 and was producing at a rate of 480,000 metric tons per year of high-quality anthracite during 2000 (James Hall, May13, 1999, Coal leads the way as Swazi mines crank up mineral output, accessed June 18, 1999, at URL http://www.bday.co.za/99/0513/world/w9.htm). All the anthracite coal production was exported to South Africa. The Mapaka Collieries and the Moaka Collieries, which were the country's two other coal mines, were still closed but had remaining coal reserves of 30 million metric tons each. The Natural Resources and Energy Ministry was seeking investors to reopen these coal mines (Southern Africa Development Community-European Union, October 10-13, 2000, SADC-EU mining investment forum—

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[1] Where necessary, values have been converted from Swazi emalangeni (E) to U.S. dollars at the rate of E7.1=US$1.00 for 2000 and E6.11=US$1.00 for 1999.

Mines 2000 projects—Swaziland, accessed April 12, 2001, at URL http://www.mines2000projects.com/swazi.htm).

Stone, Crushed.—The production of crushed stone for road building and construction stone decreased sharply by 55% from 1998 to 1999. Although final data was not available, it was expected to rebound during 2000 with the approval for construction of the Nhlangano-Lavumisa highway, the Ngwenya-Mbabane highway, the Siteki-Mhlumeni road, continued work on the Mbabane-Manzini highway, and the Maguga Dam.

Major Sources of Information

Ministry of Natural Resources and Energy
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Geological Survey and Mines Department
P.O. Box 9
Mbabane, Swaziland
Telephone: (268)-42-411
Fax: (268)-45-215

TABLE 1
SWAZILAND: PRODUCTION OF MINERAL COMMODITIES 1/

Commodity 2/		1996	1997	1998	1999	2000 e/
Asbestos, chrysotile fiber	metric tons	26,014	25,888	27,693	22,912	11,000
Coal, anthracite	thousand metric tons	129	203	410	426	380
Diamond	carats	75,000	--	--	--	--
Stone, quarry products	thousand cubic meters	221	456	453	250	350

e/ Estimated. -- Zero.

1/ Reported data from Swaziland Geological Survey and Mines Department or Central Bank. Includes data available through April 2001.

2/ In addition to the commodities listed, modest quantities of crude construction materials (brick clay and sand and gravel) and pyrophyllite are produced, but output is not reported quantitatively, and information is inadequate to make reliable estimates of output levels.

THE MINERAL INDUSTRY OF

TANZANIA

By Thomas R. Yager

Following the rebirth of the Tanzanian gold industry in 1999, gold has dominated the mineral industry of Tanzania. In recent years, the mineral industry of Tanzania has also produced iron ore and steel and such industrial minerals as bentonite, kaolin, and other clays; calcite; diamond and other gemstones; graphite; gypsum; phosphate rock; salt; silica sand; and soda ash (table 1). The country also has produced coal, petroleum products, and such building materials as cement, limestone, and sand and gravel. Deposits of cobalt, copper, natural gas, nickel, and titanium also are known to occur in Tanzania.

Tanzania's gross domestic product (GDP) grew by 4.9% in 2000 compared with 4.7% in 1999 and 4% in 1998. After growing by 9.1% in 1999 and 27.4% in 1998, the value of output in the mining sector grew by 13.9% in 2000. The value of output in the mining sector nearly doubled from 1996 to 2000 owing to substantial increases in diamond and gold production. In 2000, manufacturing accounted for 8.3% of the GDP; construction, 4.6%; electricity and water, 1.7%; and mining, 2.3% (Bank of Tanzania, 2001, Gross domestic product (GDP) at factor cost by kind of economic activity at constant 1992 prices—Mainland Tanzania, accessed August 10, 2001, at URL http://www.bot-tz.org/Statistics/qreviews/table1_5.htm).

The U.S. Central Intelligence Agency (2000) estimated that Tanzania's GDP amounted to about $25.1 billion at purchasing power parity. The per capita income was $710 at purchasing power parity in 2000.

In recent years, Tanzania's mineral exports have increased substantially. Most of the increase was attributable to gold exports, which increased to $120.53 million in 2000 from $3.34 million in 1998. During the same period, diamond exports increased to $45.75 million from $12.11 million, and gemstone exports, to $18.50 million from $8.13 million. From 1998 to 2000, exports of tanzanite totaled $32 million (African Mining Intelligence, 2001; Mchihiyo, 2001).

Commodity Review

Metals

Cobalt, Copper, and Nickel.—Barrick Gold Corp. has been exploring the possibility of mining the Kabanga nickel sulfide deposits in northwestern Tanzania. Resources have been estimated to be 12.7 million metric tons (Mt) at an average grade of 2.1% nickel, 0.3% copper, and 0.16% cobalt (cutoff grade of 1.2% nickel). Previous owner Sutton Resources Ltd. had planned to produce about 17,000 metric tons per year (t/yr) of nickel, 1,600 t/yr of copper, and 1,200 t/yr of cobalt. Barrick's Bulyanhulu gold mine was expected to produce 20,000 t/yr of copper concentrates at a grade of 18% copper. Goldstream Mining NL was also exploring for cobalt, copper, and nickel at Luwumbu, Mbozi, Mibango, Mwahanza, Rukwa, and Wansisi (Jones, 1999; Goldstream Mining NL, 2000, p. 16-17; African Mining, 2001a; Mchihiyo, 2001).

Gold.—From 1995 to 2000, expenditures on exploration and mine development in Tanzania exceeded $1 billion; most of this spending has been directed toward gold (Goldstream Mining NL, 2000, p. 14-15). As a result, Tanzania's gold production has increased to 15,060 kilograms (kg) in 2000 from 318 kg in 1996 (table 1).

The Geita gold mine [owned by Anglogold Ltd. (50%) and Ashanti Goldfields Co. Ltd. (50%)] started production in August. By the end of the year, Geita had produced 5,500 kg of gold from 1.24 Mt of ore. Anglogold and Ashanti planned to increase production to about 15,600 kilograms per year (kg/yr) of gold. Total resources at the Geita Mine amounted to 90.1 Mt a grade of 4 grams per metric ton (g/t) gold. Measured resources were 47.2 Mt at a grade of 3.6 g/t gold, and indicated resources, 42.9 Mt at a grade of 4.5 g/t gold. Total reserves amounted to 63.6 Mt at a grade of 3.8 g/t gold. Proven reserves were 41.3 Mt at a grade of 3.5 g/t gold, and probable reserves, 22.3 Mt at a grade of 4.5 g/t gold (Ashanti Goldfields Co. Ltd., 2001, p. 21-22).

In 2000, the Golden Pride Mine (owned and operated by Resolute Mining Ltd.) produced 7,007 kg of gold from 2 Mt of ore mined. Measured resources were reported at 10.14 Mt at a grade of 2.3 g/t gold; indicated resources, 2.93 Mt at a grade of 3 g/t gold; and inferred resources, 2.3 Mt at a grade of 2 g/t gold. Total contained gold resources amounted to 36,700 kg. Proven reserves were 7.97 Mt at a grade of 2.9 g/t gold, and probable reserves, 432,000 metric tons at a grade of 2.7 g/t gold. Total contained gold reserves amounted to 24,300 kg (Resolute Mining Ltd., 2001, p. 5).

Barrick's Bulyanhulu gold mine was expected to start production in the second quarter of 2001; the company planned to produce 12,400 kg/yr of gold by 2004. Investment in Bulyanhulu amounted to $280 million. Resources at Bulyanhulu were reported to be 30.75 Mt containing 454,000 kg of gold. Proven reserves were 1.03 Mt containing 14,600 kg of gold. Probable reserves were 22.34 Mt containing 297,000 kg of gold (Barrick Gold Corp., 2001, Gold mineral reserves and mineral resources, accessed September 28, 2001, at URL http://www.barrick.com/op_mineral_summary.asp).

East African Gold Mines Ltd. (EAGM) announced plans to start production at the North Mara gold mine in northwestern Tanzania in the first half of 2002. EAGM planned to produce 5,800 kg/yr at a cash operating cost of $190 per ounce. The company's overall investment in the North Mara project was reported to be $90 million, of which $30 million had already been spent. Other shareholders in the North Mara project included Anglogold, Commonwealth Development Corp. (CDC) of the United Kingdom, and Macquarie Bank Ltd. of Australia. Mineral resources at North Mara were estimated to be 49.6 Mt at an average grade of 2.55 g/t gold. Reserves amounted to 19.1 Mt at a grade of 3.3 g/t gold (Africa Energy & Mining, 2000a; African Mining, 2000a, 2001b).

In 2000, Barrick took over Pangea Goldfields Inc., which held properties with substantial gold resources in Tanzania. The company's largest project was Golden Ridge, which has resources of 68,400 kg of gold. Pangea was in a joint venture with Anglogold to explore the Village and Chocolate Reef, which has a combined resource of 56,000 kg of gold. The Tulawaka project, which has indicated resources of 1.51 Mt containing 21,900 kg of gold, was a joint venture with Explorations Minieres du Nord Ltee of Canada. The company was involved in 11 projects being held in 32 prospecting licenses (African Mining, 2000a).

Spinifex Gold Ltd. also held interests in gold projects with considerable gold resources. Nyakafuru, which was the largest deposit, has resources of 3.5 Mt at a grade of 6.3 g/t gold. The Kitongo deposit had 14,900 kg of contained gold resources, of which 28% was measured, 57% was indicated, and 15% was inferred. Buckreef has 12,100 kg of contained gold resources, of which 75% is measured, 15% is indicated, and 10% is inferred. The inferred resources at Rwamagaza amount to 1,900 kg of gold. Spinifex engaged in drilling at the Buckreef, the Kitongo, and the Nyakafuru deposits in 2000 and planned to spend $1.5 million on exploration at these deposits in 2001 (Spinifex Gold Ltd., 2001, p. 3; Tassell, 2001).

In 2000, Mincor Resources NL started drilling at its Geita gold project in the Geita Greenstone Belt about 50 kilometers (km) west of Ashanti's Geita Mine. In September, Twigg Minerals plc started a reverse circulation drilling program at the Miyabi concession. Maiden Gold NL continued its exploration at Mwagi Magi. Goldstream Mining NL explored for gold at the Buhemba and Rukwa concessions (African Mining, 2000b; Goldstream Mining NL, 2000, p. 16-17).

Iron and Steel.—From 1996 to 2000, Tanzania's production of steel averaged 10,000 t/yr (table 1). Tanzania produced iron ore from the Itewe deposit near Chunya until 1997. Resources at this deposit were estimated to be 50 Mt at a grade of 32% iron. The Liganga iron ore deposit has proven resources of 45 Mt at a grade of 52% iron. State-owned National Development Corp. (NDC) was seeking investors to help develop the Liganga deposit. Resources from deposits in the Uluguru Mountains were estimated to be 8 Mt at a grade of 40% iron and 10% titanium. Goldstream Mining was exploring for iron ore at Mwahanza (Tanzania Ministry of Energy & Minerals, 1998, p. 73-74; Goldstream Mining NL, 2000, p. 17).

Industrial Minerals

Cement.—Tanzania's consumption of cement was estimated to have remained unchanged in 2000. Consumption increased by 8.3% in 1999 owing to gold mine development, infrastructure works, and large construction projects. The majority of cement consumption was attributable to the housing sector, especially concrete block manufacturers. The country's three cement producers were Tanzanian Portland Cement Co. Ltd., with a capacity of 700,000 t/yr of cement; Tanga Cement Co. Ltd., 500,000 t/yr; and Mbeya Cement Co. Ltd., 300,000 t/yr. Cement was exported to Burundi, Comoros, Rwanda, and Uganda. Tanzania's cement consumption was predicted to increase by 7.7% in 2001 (International Cement Review, 1998, 2001).

Diamond.—Production at the Williamson Mine increased substantially in 1999 and 2000 owing to the reprocessing of old tailings. In 2000, the mine produced 317,000 carats valued at $46 million from nearly 2.96 Mt of ore. From 1995 to 1999, gem-quality diamond accounted for about 85% of total diamond production in Tanzania. Diamond resources were estimated to be 114 Mt containing 6.5 million carats (DeBeers Group, 2001, p. 41, 56; Weber and Zsak, 2001, p. 222).

Gemstones.—African Gem Resources Ltd. (Afgem) acquired the rights to mine tanzanite in block C of the Merlani mining area; blocks B and D were being mined by artisanal miners. The company estimated that two-thirds of the world's known deposits of tanzanite were located in block C. Resources in block C were reported to be 2.24 Mt of ore grading 22 carats per metric ton. Afgem was developing a mine that would have a life of at least 19 years. The mine was expected to be operational in 2002 and to produce 1.5 million carats per year by 2005 (African Mining, 2000c; Mining Journal, 2001).

More than 200 different occurrences of gem minerals are known in Tanzania, particularly in the Mozambique Orogenic Belt. In recent years, alexandrite has been produced at Tunduru; aquamarine, at Mhuva; cat's eye, at Lake Manyara and Tunduru; emerald, at Lake Manyara; garnet, at Magagoni and Tunduru; opal, at Kasulu; olivine, at Gelai; ruby, at Mahenge, Matombo, Morogoro, and Tunduru; sapphire, at Songea, Tunduru, and the Umba Valley; scapolite, at Dodoma; spinel, at Tunduru; topaz, at Magagoni; tourmaline, at Mhuva and Same; and zircon, at Tunduru (Kane, 1999; Shigley and others, 2000, p. 311, 313, 315, 318-323, 325).

Limestone and Marble.—The Tanga and the Wazo Hill limestone deposits have been exploited for use in the cement industry; resources amount to more than 135 Mt at Tanga and 20 Mt at Wazo Hill. Other substantial limestone deposits include Lindi. Marble from the Mbarali deposits has been used for the production of lime. Resources from these deposits were estimated to be 137 Mt. The Msowrwa-Msehe deposit has calcitic marble resources of about 121 Mt that would be suitable as an additive in the smelting of iron ores (Bosse and others, 1996, p. 430-431, 441, 445).

Salt.—The domestic demand for salt was nearly 120,000 t/yr. Tanzania's salt production declined by 19.3% from 1996 to 2000 (table 1). Domestic salt producers included H.J. Stanley & Sons Ltd., Mtawanya Saltworks Ltd., Mtwara Oceanic Products Ltd., and Nyanza Salt Mines (T) Ltd. Substantial deposits of rock salt occur near Mandawa (Tanzania Ministry of Energy & Minerals, 1998, p. 88).

Soda Ash.—In 1999, Tanganyika Gold NL acquired a 100% interest in the Lake Natron soda ash project. In 2000, the company, which changed its name to Renewable Energy Corporation Ltd., allowed its license on the project to lapse after unsuccessfully searching for a joint partner. Lake Natron, which is located in northern Tanzania, is a soda-rich saline lake that contains large areas of evaporite crust and an underlying brine layer. Crust resources were estimated to be 109 Mt at a grade of 40% sodium carbonate, and brine resources, 27 Mt at a grade of 18% to 21% sodium carbonate (African Mining, 1999, 2000b).

Mineral Fuels

Coal.—The Kiriwa coalfield produced about 35,000 t/yr of bituminous coal, most of which was consumed by a nearby powerplant. Bituminous coal resources at Kiriwa were estimated to be 140 Mt. Deposits known to occur in the Ruhuhu coalfield include the Mchuchuma, with resources of 199 Mt; the Mbalawala, 98 Mt; the Mbuyura, 15 Mt; and the Ketewaka. NDC held a prospecting license for the Mchuchuma and the Ketewaka deposits and was seeking financing from investors to develop these deposits. Other bituminous coalfields included the Njuga, with resources of 23 Mt; and the Gahula, with resources of 2 Mt. The largest subbituminous coalfield was the Mhukuru, which has estimated resources of 150 Mt. The Ufipa coalfield has estimated subbituminous resources of 10 Mt in the Muze sector, and 7.5 Mt in the Namwele sector (Tanzania Ministry of Energy & Minerals, 1998, p. 92).

Natural Gas.—The Mnazi Bay gasfield was estimated to have reserves of about 28 billion cubic meters PanAfrican Energy Corp. Ltd. (formerly Ocelot International Ltd.) operated the Songo Songo gasfield, which has recoverable reserves of about 14 billion cubic meters and total reserves of about 28 billion cubic meters. The Songas project, which consisted of exploitation of the Songo Songo field and the construction of a 232-km pipeline to Dar es Salaam, was held up by environmental and financing concerns. The World Bank planned to provide $200 million to finance the project but was still studying the plans at the end of 2000. Other partners in the project included AES Corp. of the United States and CDC. The Songas project was expected to start production in 2003 (Indian Ocean Newsletter, 2000; Mbendi Information Services, October 4, 2000, Oil and gas industry—Tanzania—Natural gas, accessed October 25, 2001, at URL http://mbendi.co.za/indy/oilg/gas_/af/ta/p0005.htm).

Petroleum.—The petroleum refinery at Dar es Salaam had a capacity of 14,900 barrels per day. In February, the Government agreed to shut down the refinery on the grounds that it was no longer competitive. For the fiscal year ending in June 2000 (fiscal year 1999-2000), the value of imported petroleum products increased to $153.4 million compared with $104.1 million in fiscal year 1998-99. For calender year 1999, the country consumed an estimated 5.49 million barrels of refined petroleum products (Cross, 2001; U.S. Energy Information Administration, March 2001, Great Lakes region fact sheet—Burundi, Kenya, Rwanda, Tanzania, and Uganda, accessed April 19, 2001, at URL http://www.eia.doe.gov/emeu/cabs/eafrica2.html).

Tanzania Petroleum Development Co. initiated the country's first offshore licensing round in September. The inventory included six deepwater blocks covering a total of 64,050 square kilometers in the Mafia offshore deep-sea basin. In December, Dublin International Petroleum (Tanzania) Ltd. announced that it was drilling a new exploratory well in the Mandawa concession (Cross, 2001; U.S. Energy Information Administration, March 2001, Great Lakes region fact sheet—Burundi, Kenya, Rwanda, Tanzania, and Uganda, accessed April 19, 2001, at URL http://www.eia.doe.gov/emeu/cabs/eafrica2.html).

Infrastructure

In 1999, Tanzania generated 2,250 gigawatthours (GWh) of electricity, of which 78% was provided by hydroelectric power sources, and 22%, by fossil fuels. In the same year, Tanzania imported an estimated 40 GWh of electricity; the Government of Uganda was considering increasing its electricity exports to Tanzania. The country had installed capacity of 620 megawatts (MW) in 1999, of which 381 MW was for hydroelectric power. Hydroelectric power stations included Kidatu, with a capacity of 204 MW; Mtera, 80 MW; Pangani Falls, 68 MW; and Hale, 21 MW. Thermal power stations included Umbongo with a capacity of 112 MW. The Kihansi hydroelectric power station increased national capacity by 180 MW in 2000 (Africa Energy & Mining, 1999, 2000b). Tanzania's exploitable potential hydroelectric energy has been estimated to be 20,000 MW (World Resources Institute and others, 1996, p. 288). Potential areas for development of geothermal power include Kisaki Tagalala, Mbeya, and Ngorongoro.

Tanzania had about 88,200 km of roads, of which approximately 3,700 km was paved, and a 3,600-km rail network. The country had 982 km of crude petroleum pipelines. Lakes Nyasa, Tanganyika, and Victoria were being used as the principal waterways. The major import/export harbor was at Dar es Salaam; other lake and Indian Ocean ports were at Bukoba, Kigoma, Kilwa Masoko, Lindi, Mtwara, Mwanza, Pangani, Tanga, Wete, and Zanzibar (U.S. Central Intelligence Agency, 2000).

Outlook

Tanzania's mineral industry, particularly gold mining, is likely to grow substantially in the near future. With the opening of mines at Bulyanhulu, Geita, and North Mara, the country's gold production is likely to increase to more than 30,000 kg in 2001. Increases in the capacities of these mines and the opening of other new mines could boost gold production to nearly 53,000 kg in 2007. Planned investment of $1.5 billion from 2000 to 2007 could increase capacity by 50,000 kg. The International Cement Review (2001, p. 286) predicted that cement consumption would grow by nearly 8% in 2001, which may lead to higher demand for domestic gypsum and limestone.

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TABLE 1
TANZANIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000
Calcite e/		40	40	40	40	40
Cement, hydraulic	thousand tons	726 r/	621 r/	778 r/	833 r/	833
Clays:						
Bentonite e/		75	75	75	75	75
Kaolin		1,332	1,000 r/	1,200 r/	1,500 r/	1,500 e/
Coal, bituminous e/		52,000 4/	35,000	35,000	35,000	35,000
Diamond 5/	carats	126,670	123,100	97,800 r/	234,800 r/	354,400
Gemstones, excluding diamond 6/	kilograms	142,160 r/	509,489 r/	48,518	95,200 r/	150,800
Gold, refined	do.	318	232 r/	427 r/	4,767 r/	15,060
Graphite		6,776	11,000	--	--	--
Gypsum and anhydrite, crude		55,400	46,300	59,100 r/	40,000 r/	60,000
Iron ore		86,400	91,200	--	--	--
Limestone, crushed		1,200,000	-- r/	1,181,200 r/	1,241,200 r/	1,500,000
Petroleum fuels		336,000	313,000	312,000	287,000	117,000
Phosphate minerals:						
Apatite		28,020	3,000	1,935	--	--
P_2O_5 content		8,686	930	600	--	--
Salt, all types		86,700	72,500 r/	75,000 r/	35,000 r/	70,000
Sand, glass e/		4,200	4,200	4,200	4,200	4,200
Soda ash e/		300	300	300	300	300
Steel		7,733	12,498	9,522	8,982	11,182

e/ Estimated. r/ Revised. -- Zero.

1/ Includes data available through March 2000.

2/ Estimated data are rounded to no more than three significant digits.

3/ In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (other clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

4/ Reported figure.

5/ Diamond figures are estimated to represent 85% gem-quality or semigem-quality and 15% industrial-quality stones.

6/ Precious and semiprecious stones produced included amethyst, chrysoprase, emerald, peridot, rhodolite, ruby, tanzanite, and tourmaline. tourmaline.

THE MINERAL INDUSTRY OF

TUNISIA

By Philip M. Mobbs

Producing and processing of crude oil, mining of phosphate rock, and manufacturing of phosphate-based fertilizer products were significant segments of the Tunisian minerals economy. The gross domestic product (GDP) at current (2000) prices of this North African nation was estimated to have been more than $19 billion[1] in 2000 (Central Bank of Tunisia, 2001, p. 42). Hydrocarbon production and processing accounted for about 3% of the GDP, and mining and solid mineral processing accounted for about 1%.

The value of total exports during 2000 was reported to be about $5.8 billion. The value of exports of cement, phosphate-based fertilizers, phosphate rock, salt, zinc, and other minerals was estimated to be $542 million. The value of crude oil and petroleum products was about $1 billion. For 2000, the total value of imports was estimated to be $8.6 billion, of which imports of mineral fuels accounted for $873 million (Central Bank of Tunisia, 2001, p. 105, 113).

Commodity Review

Metals

Iron and Steel.—Iron ore production declined in 2000. Société du Djebel Djerissa produced about 76% of its iron ore output from the underground Djerissa Mine and about 24% from the open pit Tamera-Douaria operation. The Société Tunisienne de Sidérurgie's steel plant at El Fouladh produced record volumes of cast iron [195,600 metric tons (t)] and steel (237,000 t). National imports of steel sections and bars also increased to 715,200 t in 2000 from 697,000 t in 1999 (Central Bank of Tunisia, 2001, p. 67, 115; Institut National de la Statistique, 2001, p. 12). During 2000, Danieli Morgårdshammar S.A. began the installation of a five-stand continuous finishing mill at the Intermetal S.A. steel bar and section mill in Tunis.

Lead and Zinc.— Lead and zinc have been mined intermittently in Tunisia since Roman times. Breakwater Tunisia S.A. operated the underground Bougrine lead-zinc mine. Additional lead-zinc ore was mined at the Boujabeur Mine of Société Minière du Nord-Ouest and at Nar d'Hal. In 2000, Breakwater produced 72,246 t of zinc concentrates that contained 38,303 t zinc and 9,418 t of lead concentrates that contained 6,215 t lead from the 422,120 t of ore it milled (Breakwater Resources Ltd., 2001a, p. 22). Breakwater undertook several exploration drilling programs; these included underground drilling in the mine, which confirmed the potential of deeper ore; exploratory drilling of the Kebbouch-Sud property; delineation drilling of the shallow F1 ore body; and a deep exploratory drilling program at Bougrine. Breakwater also was building a desalinization plant at the mill.

International interest in developing Tunisian lead-zinc deposits continued to grow during 2000. Aurora Gold Corp. of the United States acquired additional zinc prospects, which included the El Mohguer, the Hammala, and the Jebel Oum Edeboua prospects, from High Marsh Holding Ltd. of the British Virgin Islands and applied to the Government for 10 exploration permits in the Kebbouch District adjacent to the Hammala property. Subsequently, Billiton UK Resources B.V. concluded negotiations for the right to earn 51% of Aurora Gold's interest in the Hammala zinc property and the 10 contiguous exploration permits to the Hammala property. By the end of May, Aurora Gold had transferred its Tunisian mineral interests to Aurora Metals (BVI) Ltd. In September, after a summer of reconnaissance mapping, soil and stream sediment sampling, and geophysical surveying, Aurora Metals terminated its option on High Marsh's El Mohguer, the Hamman Zriba/Jebel Guebli, the Jebel Oum Edeboua, the Koudiat Sidii, and the Ouled Moussa properties.

In 1999, High Marsh optioned its interest in the Djebba zinc-lead property to CSI Capital Solutions Inc. and its interest in the Fej Lahdoum zinc property to Consolidated Global Minerals Ltd. In March 2000, Consolidated Global Minerals acquired an option on CSI Capital Solutions' interest in Djebba. In June, Consolidated Global Minerals formed a joint venture with International Bravo Resource Corp. for the exploration of the Djebba property. Prior evaluation of the property for the Government had resulted in a resource estimate of 2.66 million metric tons (Mt) at a grade of 6.14% zinc and 3.34% lead (International Bravo Resource Corp., 2001, p. 3).

Industrial Minerals

Cement.—Privatization of Government cement plants continued in 2000. Société des Ciments Artificiels de Tunis was sold to Colacem S.p.A. of Italy. Secil-Companhia Geral de Cal e Cimento, S.A., of Portugal acquired Société des Ciments des Gabés, and Société des Ciments d'Oum el-Kélil was sold to a Portugese group.

Phosphate.—In 2000, open pit mining accounted for about 90% of the 12.9 Mt of crude phosphate rock that the Compagnie des Phosphates de Gafsa mined primarily from the Kef Eschfair Mine, which accounted for 29.5% of total ore volume; the Kef Eddour Mine, 19.6%; and the Jallabia Mine, 18.2%. The underground M'rata Mine was closed in 2000. The company produced more than 8.3 Mt of washed phosphate rock; this record production was aided by the increased yields from the washing plants (64.4% in 2000 compared with 63.3% in 1999).

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[1] Where necessary, values have been converted from Tunisian dinars (TD) to U.S. dollars at an average rate for 2000 of TD1.372=US$1.00.

Reduced local demand resulted in the stockpiling of about 1 Mt of phosphate in 2000 and left the company with a 2.7-Mt stockpile of marketable phosphates at the end of the year (Central Bank of Tunisia, 2001, p. 57).

Groupe Chemique Tunisien responded to the drop in international market demand for phosphoric acid with increased diammonium phosphate production.

Salt.—In 2000, reported salt production ranged from 481,000 to 620,000 t (Central Bank of Tunisia, 2001, p. 57; Institut National de la Statistique, 2001, p. 13). Salt was produced from the Sfax salt flats (about 59% of total Tunisian salt production), the Sousse salt flats (22%), and the Zarzis salt flats (19%). No salt has been produced from the Megrine salt flats since 1998.

Mineral Fuels

In 2000, increased production of natural gas, which was primarily from the offshore Miskar Field, reached 2,220 million cubic meters (Institut National de la Statistique, 2001, p. 14). The Tarfa gasfield began production in April, and the Oued Zar Field, in July. British Gas Tunisia Ltd. continued the expansion of the Hannibal gas plant, which treated gas from the Miskar Field.

Crude oil production from the major Tunisian oilfields continued to decline. Production from El Borma Field dropped by 17.2%, and that from the offshore Ashtart Field, by 12.2% (Central Bank of Tunisia, 2001, p. 61). In 2000, eight exploration wells were drilled onshore, and one, offshore; two discoveries were made. Nuevo Energy Co. acquired interest in the Anaguid and the Fejaj permits from Bligh Tunisia Inc. Athanor Tunisia B.V. acquired MOL Tunisia Oil and Gas Co. Ltd.'s interest in the Kebili permit and the Sabria production area.

Tunisian oil exports benefited from rising international prices of crude oil. In 2000, the average price of exported crude was $28.55 per barrel compared with $17.64 in 1999 and $12.06 in 1998 (Central Bank of Tunisia, 2001, p. 61).

Reserves

In 2000, proven and probable reserves at the Bougrine Mine were 1.975 Mt at a grade of 11.2% zinc and 2.1% lead (Breakwater Resources Ltd., 2001b, p. 33). Crude phosphate rock reserves were estimated to be 100 Mt (Jasinski, 2001). Crude petroleum reserves were estimated to be 308 million barrels, and reserves of natural gas, about 78,000 million cubic meters as of January 1, 2000 (U.S. Energy Information Administration, June 2000, Tunisia—Energy overview, Country Analysis Briefs, accessed October 2, 2000, at URL http://www.eia.doe.gov/emeu/cabs/tunisia.html).

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Major Sources of Information

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TABLE 1
TUNISIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000
METALS						
Iron and steel:						
Iron ore and concentrate, gross weight		238	252	220	219 r/	182
Fe content		129	137	119	119 r/	98
Metal:						
Pig iron		151	152	123	180	196
Steel, crude		187	195	171	229	237
Lead, mine output, Pb content	metric tons	4,764	1,424	4,272	6,589	6,602
Silver metal, primary e/	kilograms	3,000	300	2,500	4,000	3,700
Zinc:						
Concentrate, gross weight	metric tons	58,044	5,389	57,036	89,213	74,996
Zn content	do.	31,920	2,967	31,368	49,066	41,247
INDUSTRIAL MINERALS						
Barite	do.	15,360	12,841	8,011	530 r/	3,702
Cement, hydraulic 4/		4,566	4,424	4,588	4,864	5,409
Clays, for construction and clay products		3,175	3,280	3,478	3,670	3,870
Fertilizers:						
Triple-superphosphate		791	748	767	812	805
Phosphoric acid		1,093	984	1,184	1,208	1,043
Diammonium-phosphate		928	745	919	1,048	1,113
Ammonium nitrate		186	165	156	172	182
Fluorspar, acid grade	metric tons	720	1,426	1,190	520 r/	--
Gypsum e/ 5/		100	100	100	100	100
Lime		464	466	482	475	471
Phosphate rock, washed:						
Gross weight		7,167	6,941	7,901	8,006	8,339
P_2O_5 content e/		2,150	2,140	2,370	2,400	2,500
Salt, marine		477	393	473	447 r/	481
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross	million cubic meters	1,027	1,866	1,899	1,819	2,220
Dry e/	do.	800	1,500	1,500	1,450	1,750
Petroleum:						
Crude	thousand 42-gallon barrels	32,229	26,841	30,570	30,960	28,207
Refinery products:						
Liquefied petroleum gas	do.	1,573	1,353	1,473	1,288	1,279
Gasoline	do.	3,040	3,179	2,951	3,096	3,301
Kerosene	do.	1,012	827	978	1,194	1,216
Distillate fuel oil	do.	4,261	4,842	4,178	3,812	4,010
Residual fuel oil	do.	4,292	3,956	4,202	4,149	4,346
Other e/	do.	550 r/	2,000 r/	800	1,420 r/	940
Total e/	do.	14,700 r/	16,200 r/	14,600 r/	15,000 r/	15,100

e/ Estimated. r/ Revised. -- Zero.

1/ Data available as of March 30, 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ In addition to the commodities listed, a variety of crude construction materials (sand and gravel and stone) was produced, but output was not reported, and available information was inadequate to make estimates of output.

4/ Includes white cement production, in thousand metric tons: 1996--168, 1997--155, 1998--167, 1999--192, and 2000--250.

5/ Does not include phosphatic gypsum (waste product) generated during fertilizer production.

THE MINERAL INDUSTRY OF

ZAMBIA

By George J. Coakley

Zambia is a landlocked country in southern Africa with an area of 752,614 square kilometers, a population of 10 million people, and for 1999 (the latest year for which data were available) a per capita gross domestic product (GDP) of $880,[1] based on 1999 purchasing power parity estimates. Overall, mining and quarrying accounted for about 5% of real GDP, 80% of merchandise exports, and about 38,500 jobs, or about 8% of total employment (Zambia Investment Center, April 19, 1999, Zambia—Country profile, accessed February 12, 2000, at URL http://www.zic.org.zm/profile.htm). In 1999, total merchandise exports were $842 million, of which copper accounted for $372 million, and cobalt, $95 million. Fuel and energy imports accounted for $115 million of total merchandise imports of $871 million. The mining sector was dominated by copper and cobalt production. Zambia ranked as the world's 5th largest producer of cobalt, 12th of copper, and one of the top producers of gem-quality emeralds in 2000. Besides copper and cobalt, Zambia produced gold, selenium and silver as byproducts of copper refining, a variety of industrial mineral commodities, and coal (table 1). Gemstones, mostly emeralds, recorded significant earnings, but probably an even larger amount bypassed official channels. During 2000, Zambia completed privatization of Zambian Consolidated Copper Mines (ZCCM) assets and began its first full year of private ownership and operation of the copper industry since 1968.

Government Legislation and Policies

The Investment Act of 1993 established the Zambia Investment Center as a one-stop support facility for investors and offers incentives to investors in the mining sector. The act, as amended in 1996, regulates, for example, investment incentives and investment guarantees. Investment is protected by the Securities Act (for the stock exchange) and the Investment Act against compulsory acquisition. No investment can be expropriated unless Parliament has passed an act that relates to the compulsory acquisition of that property. In the event of expropriation, the 1993 Investment Act, as amended, guarantees full compensation at market value and free transfer of the funds in the currency in which the investment was made. In December 1994, the Government announced that it would no longer participate in exploration or become a shareholder in a mining company and would limit its functions to regulatory or promotional activities. The Companies Act (1994) has brought Zambia's company law in line with modern British company law. The Mines and Minerals Act of 1995, which was passed by Parliament as 1995 Act No. 31 on September 13, 1995, is aimed at attracting risk capital, technology, and entrepreneurial efforts to the mining sector. The Mines and Minerals Act officially put in place a mineral policy that calls for a privatization program to encourage private development and diversification of the mining sector. The act commits the Government to promote small-scale mining; to development of gemstone mining and liberalization of gemstone marketing facilities; to diversification of mining through development of industrial, ferrous, and energy minerals; to reduction of ecological damage arising from mining; and to promotion of local value-added processing of Zambia's mineral raw materials. The law covers all mineral commodities and treats large-scale, small-scale, and gemstone operations separately as to mineral rights (prospecting and mining authorizations). Export of radioactive minerals, such as monazite, is illegal without special Ministerial approval. It also gives the Government leeway in negotiating individualized contracts with investors. Among other provisions were secure title to mining rights with provision to assign, the right to market products, international arbitration, exemption from import duties and sales taxes on material at least for an initial period of exploration and development, and royalty charges of 3% for large-scale mining license holders on the "net back value" of minerals free-on-board, less transport and smelting and refining costs. By 2000, privatization of most of the major mines had been completed, and efforts were ongoing to privatize the gemstone and other small mines sector and to attract foreign investors to develop other known metallic and industrial mineral resources.

Environment

Parliament's Environmental Protection and Pollution Control Act (No. 12) of 1990 is the basis for the formation of the Ministry of Environment and Natural Resources and also the Environmental Council of Zambia. The act, which formally came into full force in February 1992, gives the Ministry overall responsibility for protecting the environment. In March 1997, the Mines and Minerals (Environmental) Regulations were passed to implement environmental protection provisions of the Mines and Minerals Act of 1995. The 1997 environmental legislation established an environmental protection fund and regulations for environmental impact assessments, mine dumps, air and water quality, and emission.

In November 2000, the World Bank released a proposal to fund a 5-year $59 million Copper Belt environmental project to be implemented by the Government and Zambian Consolidated Copper Mines Investments Holdings Plc. (ZCCM-IH). The project was scheduled for World Bank board review and vote in May 2001. The project would be used to help ZCCM-IH address the environmental liabilities assumed by the Government after the privatization of ZCCM assets. ZCCM-IH held a minority (10% to 20%) interest in the respective newly privatized mining companies. The project was designed to develop an environmental management plan (EMP), which is an environmental management funding mechanism, and to strengthen the Government's capacity to monitor adequately the implementation of the EMP (World Bank, November 7, 2000, Zambia—Copperbelt environment project, accessed May 15, 2001, at URL http://www-wds.worldbank.org/pdf_content/000094946001123054355 37/multi_ page.pdf).

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[1] Where necessary, values have been converted from Zambian kwacha (K) to U.S. dollars at the rate of K3,225=US$1.00 for 2000 and K2,388=US$1.00 for 1999.

Production

In 2000, copper mine production continued its decline to 241,200 metric tons (t); this was a decrease of 11% compared with that of 1996 and less than 30% of the 1969 peak production of 825,000 t. Estimated cobalt mine production declined by 18%, and refined cobalt, by 19% compared with those of 1999; these were also low by historic standards. Production of byproduct gold, selenium, and silver from copper refinery slimes were all down compared with those of 1999. The new mine owners focused on mine and plant rehabilitation efforts in 2000, and based on a review of company plans, copper production is likely to be increased to 325,000 t in 2001 and to around 460,000 t by 2003. Cobalt production should also increase by a factor of 3 or 4 by 2003. Overall, gold production will drop significantly in 2001 because of the closure of the Dunrobin gold mine in November 2000.

Zambia was a major world supplier of emerald and amethyst and also produced gemstone-quality aquamarine, garnet, and tourmaline. Most gemstone mining was done by small-scale artisanal miners, and production and export levels were poorly documented. Chilanga Cement Plc, which was the country's only cement producer, maintained cement production of more than 300,000 metric tons per year (t/yr), while the Maamba coal mine was returned to production in 1999 and 2000 following the 1997 flooding of the mine. Domestic production of refined petroleum products remained impossible because Zambia's only oil refinery Indeni Petroleum was gutted by fire in December 2000; this was a day before the refinery was to begin operations after undergoing a $13 million rehabilitation following a May 1999 fire, which also severely damaged the refinery (United Nations Integrated Regional Information Networks, December 18, 2000, Zambia—Oil refinery gutted by fire again, accessed May 2, 2001, at URL http://www.reliefweb.int/IRIN/sa/countrystories/zambia/20001218a.phtml).

Trade

For many years, the major mineral exports, by value, have been copper and cobalt. Some observers, however, believe that gemstones have been very significant in export value, possibly second to copper, despite the absence of official records. In 1998, the Government indicated that the value of legally and illegally exported gemstones may be as much as $250 million per year. More than half of copper and cobalt exports went to Europe and Asia. Bulk copper was exported via rail from Zambia to the Tanzanian port of Dar es Salaam, via the Mozambican port of Beira, and through the South African ports of East London and Durban.

The principal import was petroleum, which included crude and refined products. The Arabian Gulf States were the principal sources of oil imports, and South Africa was also a major source at least partly because of transshipments from overseas sources. Fertilizer components, particularly phosphorus and potassium, were the second largest mineral import.

Commodity Review

Metals

Copper and Cobalt.—In 2000, the privatization of ZCCM and the full transition of one of the world's larger copper industries from state-owned to privately owned and operated were completed. Cobalt is produced as a byproduct of copper mining and processing. Details of the structure of the newly privatized mining industry are shown in table 2. In April, a consortium comprising First Quantum Minerals Ltd. of Canada and Glencore International AG, which was a privately owned Swiss metals trading company, finalized its agreement to purchase ZCCM's Mufulira Division (which included mines, the concentrator, the smelter, and the refinery) and selected Nkana Division assets (which included the mining operation, the concentrator, and the cobalt plant). The newly formed operating company Mopani Copper Mines Plc. (Mopani) will be owned by Glencore (46%), First Quantum (44%), and ZCCM (10%). Under the terms of the acquisition, "ZCCM received a cash consideration of $20 million upon closing and will receive deferred payments of $23 million in five equal annual installments starting in January 2003. ZCCM will also be provided with a copper price participation plan to be calculated at 2% of the copper price over and above $0.85 per pound, payable for five years from 2003 and capped at $4.4 million. Mopani will commit to invest $159 million in the Mufulira ($84 million) and Nkana ($75 million) operations over the first three years" (First Quantum Minerals Ltd., April 3, 2000, First Quantum-Glencore consortium complete transaction with ZCCM—Nkana and Mufalira assets transferred to Mopani Copper Mines Plc., accessed April 5, 2000, via URL http://www.first-quantum.com).

First Quantum also owned and operated the Bwana Mkubwa Mine near Ndola. During 2000, Bwana Mkubwa treated more than 1.8 million metric tons (Mt) of tailings in its solvent extraction-electrowinning (SX-EW) circuit; this yielded 10,025 t of copper compared with 9,621 t in 1999. The SX-EW plant also generated 61,889 t of excess sulfuric acid for sale to other Copper Belt operations. The company reported remaining reserves at Bwana Mkubwa of 4 Mt at a grade of 0.73% copper, which was sufficient for an additional 3-year mine life (First Quantum Minerals Ltd., 2001, p. 11).

For the 8 months of operation following its takeover from ZCCM in April, Mopani mined 1.2 Mt of ore at a grade of 2.2% copper at the underground Mufalira Mine; this yielded 27,754 t of copper. As part of its rehabilitation program, Mopani brought in new drilling and mining equipment that enabled it to maintain development of Mufulira Mine reserves well ahead of ore production. At yearend, Mufulira had estimated reserves of 27 Mt at a grade of 3.04% copper included in mineral resources of 69 Mt at a grade of 3.1% copper. For the 8 months of operation in 2000, Mopani mined 1.6 Mt of ore at a grade of 1.76% copper and 0.12% cobalt at the underground Nkana Mine; this yielded 18,050 t of copper and 749 t of cobalt. A combination of new equipment and improved mining practices resulted in a 20% increase in ore grades mined above the 15-year historic average of 1.5% copper. Cobalt concentrates, which averaged 7% copper and 1.6% cobalt, were sent to the Chambishi and the Nkana cobalt refineries for treatment. Reported yearend reserves at Nkana were 75 Mt at a grade of 2.26% copper and 0.14% cobalt. Mineral resources, which included reserves, were estimated to be 259 Mt at a grade of 2.19% copper and 0.10% cobalt. Mopani forecast production rates at Nkana to be 52,000 t of copper and 1,700 t of cobalt for 2001 and 63,000 t of copper and 2,300 t of cobalt for 2002 (First Quantum Minerals Ltd. 2001, p. 15-17).

In May, First Quantum purchased the exploration portfolio of Cyprus Amax Zambia (Cymax) from Phelps Dodge Exploration Corp. The Cymax assets included the Luamata, the Luswishi, the Mwinilunga, and the Solwezi prospecting licenses. Phelps Dodge received $25,000 plus a 2% to 3% net proceeds interest and the one-time back-in right to acquire a 20% participating interest following First Quantum expenditures of $5 million at Mwinilunga, $3 million at Solwezi, and $2 million at Luamata. Phelps Dodge retained the Cymax interest in the Kansanshi copper project, where identified resources totaled 150 Mt at a grade of 1.5% copper (First Quantum Minerals Ltd., May 26, 2000, First Quantum acquires exploration portfolio from Phelps Dodge, accessed July 8, 2000, via URL http://www.first-quantum.com). In November, First Quantum signed an agreement with Billiton plc. on exploration of the Lumwata and the Mwinilunga prospecting licenses, whereby Billiton can earn-in up to a 51% interest in these projects by completing $2.4 million in exploration and up to a 70% interest by arranging financing for development of any economic deposit found during exploration.

In October 1999, Zambia Copper Investments Ltd. (ZCI) (owned 50.9% by Anglo American plc) signed a heads of agreement with ZCCM to acquire the Konkola and the Nchanga Divisions. The agreement was finalized in March 2000, with the announcement that the new Anglo American company Konkola Copper Mines plc (KCM) will acquire the Konkola Division [which included the Konkola Deep Mining Project (KDMP)], the Nchanga Division (which included the Chingola refractory ore stockpiles), the Nampundwe pyrite mine, and associated infrastructure (which included the Konkola, the Nampundwe, and the Nchanga concentrators and the Nchanga tailings leach plant). KCM will be owned by ZCI (65%), ZCCM (20%), International Finance Corp. (7.5%), and Commonwealth Development Corp. Financial Services (7.5%). KCM agreed to pay ZCCM $90 million in acquisition payments plus a copper and cobalt price participation bonus scheme to be capped at $16 million per year and $125 million during the life of the scheme. In addition, KCM committed to capital expenditures of $260 million to rehabilitate the operations and, subject to financing and favorable copper markets, to develop the KDMP at an estimated cost of $523 million. In a parallel transaction, ZCI sold its 27.3% interest in ZCCM to the Government for $30 million. KCM also had an option to buy the Nkana copper smelter after March 2003 (Anglo American plc, 1999, 2000). In June, the Government of the United Kingdom provided an $81 million grant to ZCCM-IH to rehabilitate the Nkana copper smelter and refinery. The Nkana plants will be managed by KCM under an agreement with ZCCM-IH (Times of Zambia, 2000).

During the 9 months of operation following its takeover of these ZCCM assets in 2000, KCM processed 5.97 Mt of copper ore and 463,000 t of cobalt ore, which yielded 93,711 t of copper and 3,129 t of cobalt contained in concentrates. Refined production amounted to 125,385 t of copper and 1,114 t of cobalt. Efforts by KCM during 2000 focused on investing $70 million in refurbishing operational assets; reconfirming the feasibility study on the KDMP, which was expected to be completed by the first quarter of 2001; and seeking to raise long-term financing for the project. Subject to a favorable feasibility study and obtaining of finance, KCM expected to begin construction of the KDMP, which will take 5 years to complete, in 2002. KCM planned on producing 240,000 t of refined copper in 2001 (Zambia Copper Investments Ltd., 2001). The KDMP could add more than 200,000 t/yr of new copper production by 2008. Konkola deep ore reserves were estimated to be 100 Mt at a grade of 4.33% copper plus mineral resources of 55 Mt at a grade of 3.13% copper (David McKay, March 13, 2000, Anglo's ZCCM purchase is first block in base metals empire, Base metals—The mining web, accessed February 2, 2001, via URL http://www.miningweb.co.za).

Roan Antelope Mining Corp. of Zambia (RAMCOZ) (controlled by Binani Group of India) operated the Baluba and the Luanshya Mines and was examining the feasibility of developing the Muliashi deposit. Binani also owned and operated the Ndola Precious Metals Plant. The company has been faced with operational and financial problems since it took over the mines in 1998. RAMCOZ produced 24,900 t of copper and 476 t of cobalt through January 1999. Unable to pay employees, contractors, Copperbelt Energy Co. for its electrical power, or the obligations owed to the Zambia National Commercial Bank, the Luanshya underground mine was shut down in October 2000, and RAMCOZ was placed into receivership in November 2000 (Chali Nondo, The Monitor for Human Rights and Development [Zambia], November 17-23, 2000, RAMCOZ workers cry foul, accessed May 1, 2001 at URL http://afronet.org.za/monitor133/headline2.htm; World Mining Equipment, November 23, 2000, Zambia's troubled Roan Antelope Mining Corp. (Ramcoz) was put under receivership on 22 November, accessed May 2, 2001, at URL http://www.wme.com/wme/headlines/head1123.htm). With the help of temporary financing arranged in part by the Government receiver, the mine was reopened in January 2001. Problems were compounded when the Luanshya Mine was flooded by heavy rains in early March 2001. Separately, in August 2000, RAMCOZ announced plans to raise $57 million to develop the Muliashi North project at a rate of 34,000 t/yr of copper and 1,400 t/yr of cobalt, which will increase to 60,000 t/yr copper after 5 years (Business Day Online, August 18, 2000, Roan Antelope to develop copper and cobalt operation, accessed January 21, 2001, at URL http://www.businessday.co.za/bday/content/direct/1,3523,680606-6078-0,00.html).

Chibuluma Mines plc (controlled by Metorex Ltd. since late 1997) owned and operated the Chibuluma West Mine near

Kalulushi and the new Chibuluma South Mine, 12 kilometers (km) south of Chibuluma West. During 2000, the Chibuluma West Mine operated at a rate of 276,000 t/yr of ore at an average grade of 3.68% copper and 0.1% cobalt. Overall recovery rates were 87% for copper and 36% for cobalt. Production was 8,844 t/yr of cathode copper, which was smelted and refined at the Smelterco facilities, and 100 t of flake cobalt, which was refined at Mopani's cobalt refinery. As of June 30, proved and probable reserves at Chibuluma West were estimated to be 254,000 t at a grade of 3.8% copper and 0.1% cobalt and at a cutoff grade of 1.2% copper, inclusive of a dilution factor of 25% and an extraction factor of 85%. Mineral resources, exclusive of reserves, at Chibuluma West were estimated to be 981,000 t at a grade of 4.7% copper and 0.1% cobalt. Exploration during 2000 extended the life of the Chibuluma West Mine by 3 to 5 years. Current (2000) copper production of 700 metric tons per month (t/mo) from Chibuluma West will increase to 1,500 t/mo with the startup of Chibuluma South.

The $25 million Chibuluma South project was expected to begin production in April 2001. The first stage of the project will include an open pit to mine near surface ore and a new processing plant capable of treating oxide and sulfide ores at a rate of 40,000 t/mo for 4 years. In the second phase, a vertical shaft and incline ramp system will be constructed to access the underground reserves. Underground production will match the open pit's 40,000 t/mo, thus giving the mine a total life of more than 16 years. Proved mineral reserves at Chibuluma South were 7.3 Mt at a grade of 3.7% copper and at a cutoff grade of 1% copper, inclusive of dilution and extraction factors of 10% and 85%, respectively. Metorex reported an inferred resource of 1.5 Mt at a grade of 2.9% copper at the Chifupu prospect near Chibuluma South (Metorex Ltd., Our companies—Chibuluma Mines PLC, accessed May 12, 2001, at URL http://www.metorexgroup.com/Chibuluma.htm).

NFC Africa Mining plc (controlled by the Chinese parastatal China Nonferrous Materials Industry Engineering and Construction Group) announced that it was planning to invest $200 million in the Chambishi Mine project. It acquired the closed mine from ZCCM in June 1998 for $20 million. Rehabilitation work started in July 2000 and was expected to be completed and mining resumed by the end of 2002, with full operational capacity reached by 2003. Chambishi will mine 2.15 million metric tons per year (Mt/yr) of ore by using a combination of cut and fill and sublevel stoping. The mill will produce 120,000 t/yr of copper concentrates that average 40% copper. Chambishi ore reserves were reported to be 33 Mt with additional resources of more than 100 Mt. Production of 45,000 t/yr of copper was expected. The project investment will help China meet its growing need for copper imports (Atlas Copco, December 11, 2000, Major rig order for new copper mine venture in Zambia, accessed May 2, 2001, at URL http://www.miningandconstruction.com/news/news23.htm; China Economic Review, March 1, 2000, Investment in Zambian mine, accessed July 9, 2000, at URL http://www.chinaeconomicreview.com/htm/20000401cer12i.htm; Ministry of Land and Resources P.R.C., [undated], Bank digs deep for mining loan, accessed April 30, 2001, at URL http://www.mlr.gov.cn/english/Bank%20digs%20deep%20for%20mining%20loan.html).

Chambishi Metals plc [owned by Angolvaal Mining Ltd. (Avmin) of South Africa] purchased the Chambishi cobalt plant and the Nkana slag dumps from ZCCM in August 1998 for $50 million and made a commitment to invest $140 million within 3 years. The $100 million Nkana slag-processing facility was expected to begin production by early 2001. Production was expected to reach 4,000 t/yr of cobalt and 7,000 t/yr of copper by mid-2001. Resources contained in the slags were reported to be 20 Mt at a grade of 0.76% cobalt and 1.16% copper and were expected to last for more than 20 years. Avmin also was examining the potential for developing the Konkola North copper project where resources were reported to be 147 Mt at a grade of 2.15% copper. Following a $15 million refurbishment, Avmin's Chambishi cobalt plant was toll-refining concentrates for the other Copper Belt companies (Anglovaal Mining Ltd., [undated], Base metals—Chambishi Metals plc, accessed May 2, 2001, at URL http://www.avmin.co.za/operations/chambishi.asp).

During 2000, Equinox Resources Ltd. of Australia received the findings of a prefeasibility study completed on the Lumwana project by Bateman Engineering Inc. of South Africa. Equinox was earning a 50% interest in the Lumwana project from Phelps Dodge by spending $5 million during 4 years and up to 75% equity interest by covering up to $35 million of project costs during 12 years. The Lumwana project contains two large copper-cobalt-gold-uranium deposits at Chimiwunga and Malundwe. Lumwana resources were reported to be more than 1 billion metric tons that contain 0.67% copper using a 0.2% copper cutoff and 481 Mt of ore at a grade of 1.0% copper using a 0.6% copper cutoff grade. Using a 0.2% copper cutoff and a $0.85 copper price, the combined proven and probable reserves plus the inferred resource amounted to 85 Mt at a grade of 0.98% copper at the Malundwe deposit and 245 Mt at a grade of 0.64% copper at the Chimiwunga deposit. These deposits had been discovered by Roan Selection Trust Ltd. in the early 1960s. Based on a 1990 assessment, the Malundwe area also had a geological resource of 7.2 Mt at a grade of 0.14% uranium oxide. The mine feasibility study was based on a mining rate of 14.5 Mt/yr of ore during a 20-year mine life.

Conventional milling and flotation will be used at Lumwana to produce a copper-cobalt concentrate at a grade of approximately 34% copper with potential gold credits. The open pit operation would produce 102,000 t/yr of copper from years 2 to 20 and 38,000 t/yr from years 21 to 24, as well as 1,900 t/yr cobalt from years 6 to 24. Between years 2 and 6, more than 3,365 kg of gold and 3,600 t of uranium oxide could be recovered. Bateman estimated capital costs to be $340 million. During 2001, Equinox will conduct a full bankable feasibility study and also look at the potential synergies in developing the Lumwana as a combined project with Phelps Dodge's Kansanshi deposit to produce more than 200,000 t/yr of copper for more than 25 years. In a separate joint venture with Anglo American, Equinox also was exploring for iron-oxide/copper/gold and Copper-Belt-style targets in the Kitwe and Luanshya South areas, in the Kasanka and Serenjie tenements in eastern Zambia, and on the Mwombehzi Dome tenement adjacent to Lumwana in northwestern Zambia (Equinox Resources Ltd., September 29, 2000, Annual report

2000, accessed May 22, 2001, at URL http://www.eqr.com.au/pdfs/report.pdf; Equinox Resources Ltd., January 31, 2000, Equinox Resources Ltd. quarterly report to shareholders for the three months ended December 31, 2000, accessed May 22, 2001, at URL http://www.eqr.com.au/pdfs/4qtr00.pdf).

In August, Caledonia Mining Corp. of Canada signed a farm-in agreement with BHP World Minerals Inc. of Australia whereby BHP can earn a 30% interest in Caledonia Mining's Kalimba Group copper-cobalt properties by spending $2.5 million during the first 5 years and up to 50% by spending an additional $4 million. Kalimba Group included the Nama and Ngosa areas, where Caledonia Mining had previously identified a resource of about 950 Mt at a cobalt equivalent grade of 0.029% (Caledonia Mining Corp., August 29, 2000, Caledonia and BHP sign agreement on Caledonia's Kalimba Group properties in Northern Zambia, accessed May 2, 2001, at URL http://www.caledoniamining.com/aug29_00.pdf). Caledonia held other exploration licenses, which included the Kadola copper-cobalt-gold prospects examined between 1997 and 2000 by Cymax (its joint-venture partner before it withdrew from Zambia).

Industrial Minerals

Ammonia.—In February, Nitrogen Chemicals of Zambia (NCZ) announced that it would resume production of ammonia from domestic coal resources in response to the high cost of ammonia imported by rail from Sasol operations in South Africa. NCZ was rehabilitating its ammonia production plant after a 7-year shutdown and was seeking the finances to buy 5,000 t of coal from Maamba Collieries to start producing ammonia gas for nitrogen fertilizer generation (Times of Zambia, February 18, 2000, NCZ to produce ammonia gas, accessed April 30, 2000, at URL http://allafrica.com/stories/200002180039.html).

Cement.—Chilanga Cement plc. operated cement plants at Lusaka and Ndola on the Copper Belt with capacities rated at 200,000 t/yr and 290,000 t/yr, respectively. Chilanga Cement also had the capacity to produce 441,000 t/yr of clinker. The company sold more than 10% of its annual production to Copper Belt mines and maintained export markets to Malawi and other neighboring countries. During 2000, however, Chilanga Cement reported that its production costs remained high, which made competitiveness with cement imported from within the region difficult. High production costs were attributed to the high cost of coal bought from Maamba Collieries, which was reportedly five times more expensive than that from neighboring countries, and the high cost of transportation from the Maamba coal mine. Chilanga Cement also had to pay a 25% duty on imported raw materials used at its cement plants (Mackson Wasamunu, October 23, 2000, High costs disadvantage Chilanga Cement, accessed May 2, 2001, at URL http://allafrica.com/stories/200010230110.html).

Gemstones.—The gemstone-processing industry in Zambia has continued to grow as more and more companies decide to invest in this area. In December 1999, the Zambia Investment Centre Board issued a certificate to Dia Star Gemstone Ltd. of India, which planned to invest $111,000 into cutting and polishing of amethyst, aquamarine, emeralds, red garnet, and pink tourmaline for export to markets in India, Japan, and other countries in the Far East. The company, whose operations will be based at Lusaka, will employ 21 Zambians (Zambia Investment Centre, December 1999, Gemstone processing on rise in Zambia, accessed June 1, 2000, at URL http://www.zic.org.zm/december99.htm).

The Zambia Privatization Agency invited offers to purchase the 87% shareholding held by the Government (50%) and Lonrho Africa Ltd. (50%) in Kariba Minerals Ltd. (KML). The closing date for bids was October 6, 2000. KML operated the oldest and largest amethyst mine in Zambia and one of the largest deposits of high- and low-grade amethyst in the world. KML's license was within the Kaloma Mapatizya amethyst mine field, which is located in southwestern Zambia near the Zimbabwean border. Mining was done by bulldozers to remove overburden and by pick and shovel to mine amethyst selectively. Kaloma Mapatizya was estimated to have 2.5 Mt of ore that contained approximately 72,000 t of run-of-mine amethyst, or more than 2.6 million kilograms of high- and low-grade salable amethyst plus "unlimited" amounts of low-grade amethyst (Zambia Privatization Agency, [undated], Kariba Minerals Ltd., accessed March 27, 2001, at URL http://zic.org.zm/kariba.htm).

Zambia possessed a wide variety of semiprecious gemstones, most of which were exploited by artisanal and small scale miners (Africa InSites, [undated], Zambia gemstones—A buyers guide, accessed May 2, 2001, at URL http://www.africa-insites.com/zambia/info/General/gemstones.htm).

Caledonia Mining had a joint venture with BHP and Motapa Diamonds Inc. (its affiliate company) to explore the Mulonga Plain, the Kashiji Plain, and the Kakenge River licences in western Zambia for diamonds. During 2000, BHP conducted geophysical and stream-sampling programs, with a drilling program begun in the last quarter of 2000, to test an area of kimberlite indicator minerals within the Mulanga Plain license (Caledonia Mining Corp., March 31, 2001, Caledonia Mining Corp. annual report for 2000, accessed May 2, 2001, at URL http://www.caledoniamining.com/html/2000_annual_report.html).

Mineral Fuels

Coal.—Since the agreement to purchase an 80% interest in the country's only coal mine Maamba Collieries from the Government in 1997, Benicon Ltd. of South Africa (the new owner) had been faced with limited markets, floods, and other operational problems. During 1999, Maamba accumulated a 15,000-t stockpile of unsold production. During 2000, the mine produced at a rate of only 14,000 t/mo, which was equivalent to only 20% to 25% of capacity. With the failure of Benicon to meet a final deadline in August to make the last $1.5 million purchase payment on the mine, however, the Government rescinded its agreement with Benicon and repossessed the mine. Remaining proven coal reserves were estimated to be more than 60 Mt. Maamba Collieries will be offered for sale again by the Zambia Privatization Agency (Lewis Mwanangombe, Panafrican News Agency, November 30, 2000, Zambia ends coal mine deal due to irregularities, accessed May 22, 2001, at URL http://allafrica.com/stories/200011300009.html).

Infrastructure

As a landlocked country, Zambia was dependent on truck and rail transport to sustain most of its economy. The truck road and railway networks within the country and externally were reasonably adequate for access to ocean and lake ports for international trade. Major highways generally paralleled the rail lines. About 20% of the main roads were paved, and about 20% were gravel or stabilized earth. The principal rail routes were northeastward to and from the port of Dar es Salaam—which was nearly 2,000 km from Ndola in the Copper Belt—mostly on the Tanzania Zambia Railways Authority (Tazara) line and southward through Zimbabwe to and from South African ports—which are more than 2,500 km from Ndola—on Zambia Railways Ltd.'s line in Zambia. The roughly 2,000-km rail link southeast through Zimbabwe to the port of Beira in Mozambique was now more accessible following post-civil-war refurbishment of rail and port facilities in Mozambique. The more-than-2,200-km rail link north into the Democratic Republic of the Congo [Congo (Kinshasa)] and west to the port of Benguela (Lobito) in Angola has remained unavailable during the 20-year civil war in Angola. A crude oil pipeline ran about 1,700 km southeast from Dar es Salaam to a refinery in Ndola and was owned and operated by Tazama Pipelines Ltd. (a joint venture of the Zambian and the Tanzanian Governments). Essentially all Zambia's 8.16-billion-kilowatthour energy production in 2000 was from hydroelectric sources.

Outlook

The successful completion of the privatization of the copper sector held promise for the revitalization of the minerals sector of the Zambian economy. Assuming investment and copper market conditions remain favorable, more than $2 billion is expected to be invested in the rebuilding of the copper industry between 1998 and 2008. Production is expected to increase from 233,000 t/yr of refined copper and 4.2 t/yr of refined cobalt in 1999 to approximately 620,000 t/yr copper and 20 t/yr of refined cobalt by 2008. This could return Zambia to the position of the largest cobalt producer and one of the top five or six copper producers in the world.

The country, however, faces several internal and external hurdles to development, including high transportation costs, the threat that a high HIV/AIDS infection rate in the region poses on maintaining a skilled labor force, cyclical world commodity prices, and the impact of civil wars in neighboring Angola and Congo (Kinshasa), which would add to the political risk of financing new projects. Stabilization of all or some of these factors will be needed for the country to benefit fully from the expected infusion of new foreign investment and technology. Restructuring of the gemstone sector and efforts to manage the export flow of gemstones better also has the potential to generate a larger value-added industry in Zambia. A renewed exploration interest in diamond and zinc resources is also evident.

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Major Sources of Information

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TABLE 1
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 e/
METALS						
Cobalt: 2/						
Mine output, Co content		6,959	6,037	11,900	5,640	4,600
Metal, Co content		4,611	4,386	5,011	4,236	3,450 3/
Copper: 2/ 4/						
Mine output, Cu content:						
By concentration or cementation		276,000	288,900	258,000	213,000 r/	186,200 3/
Leaching (electrowon)		58,000	64,000	57,000	57,000	55,000 3/
Total		334,000	352,900	315,000	270,000 r/	241,200 3/
Metal:						
Smelter, primary:						
Electrowon (low grade)		73,900	61,140	51,736	25,000	25,000 3/
Other		250,300	220,327	206,871	184,000	169,500 3/
Total		324,200	281,467	258,607	209,000	194,500 3/
Refinery, primary:						
Electrowon		58,000	63,736	80,709	57,000	55,000 3/
Other		276,000	268,553	248,820	176,300	170,200 3/
Total		334,000	338,400 r/	240,500	233,300	225,200 3/
Gold 2/	kilograms	119	290 e/	765	700	600 e/
Selenium, refined, gross weight 2/	do.	20,016	15,161	14,670	10,170	9,820
Silver 2/	do.	9,410	6,684	8,363	5,110	4,940
INDUSTRIAL MINERALS						
Cement:		348,000	384,000	351,000	300,000	380,000
Clays:						
Brick e/		3,000	3,000	3,000	3,000	3,000
Building, not further specified e/		30,000	30,000	30,000	30,000	30,000
China and ball e/		200	200	200	200	200
Gemstones: e/						
Amethyst	kilograms	1,198,354	699,343	800,000	800,000	800,000
Aquamarine	do.	866	--	--	--	--
Beryl	do.	4,544	1,527	2,000	2,000	2,000
Emerald	do.	6,000	7,000	7,000	7,000	7,000
Garnet	do.	13,701	2,467	3,000	3,000	3,000
Tourmaline	do.	4,150	--	--	--	--
Gypsum e/		11,000	11,000	11,000	11,000	11,000
Lime, calcined e/	thousand tons	200	200	200	200	200
Limestone (for cement and lime) e/	do.	800	800	800	800	800
Magnetite, gross weight e/		-- r/	-- r/	-- r/	-- r/	--
Nitrogen, N content of ammonia e/		-- r/	-- r/	-- r/	-- r/	--
Sand and gravel, construction e/	thousand tons	200	200	200	200	200
Stone, construction:						
Limestone, crushed aggregate e/	do.	700	700	700	700	700
Other e/	do.	700	700	700	700	700
Sulfur:						
Pyrite concentrate:						
Gross weight		78,971	69,059	72,366	65,000	50,000
S content (42%) e/		33,200	29,005	30,394	27,300	21,000
Sulfuric acid: 5/						
Gross weight		206,572	178,482	134,000	119,000	110,000 3/
S content (32.6%)		67,340	58,185	43,684	38,800	35,800
Total, S content		100,540	87,190	74,078	66,100	56,800
Talc e/		80	80	80	80	80
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous e/	thousand tons	100	10	186 r/	128 r/	168 3/
Petroleum, refinery products e/ 2/	thousand 42-gallon barrels	5,000	5,000	5,000	1,700 r/	--

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through May 15, 2001.

2/ Data are for year beginning April 1 of year stated for 1996-1999.

3/ Reported figure.

4/ Terms are used as defined by the International Copper Study Group.

5/ From Nkana and Chambishi acid recovery plants.

TABLE 2
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity 2/
Cement	Chilanga Cement plc (Commonwealth Development Corp., 50.1%; general public, 30.2%; Anglo American plc, 16.7%; Civil Service Pensions Board, 6.5%)	Lusaka plant	200,000.
Do.	do.	Ndola plant	290,000.
Coal	Maamba Collieries Ltd. [Benicon Ltd. (South Africa), 80%; Zambian Governmnet, 20%]	350 kilometers south of Lusaka in Kanzie and Izuma Basins	800,000 bituminous coal (operating at 300K to 400K).
Copper-cobalt	Konkola Copper Mines plc [Zambia Copper Investments Ltd. (Anglo American plc), 65%; Zambia Consolidated Copper Mines (ZCCM), 20%; International Finance Corp., 7.5%; Commonwealth Development Corp., 7.5%]	Nchanga and Chingola open pits	4,500,000 ore.
Do.	do.	Nchanga underground mine	2,800,000 ore.
Do.	do.	Nchanga concentrator	88,000 copper in concentrate; 10,000 cobalt in concentrate.
Do.	do.	Nchanga tailings leach plant	70,000 leach cathodes.
Do.	do.	Konkola underground mine	2,200,000 ore.
Do.	do.	Konkola concentrator	50,000 copper in concentrate.
Do.	do.	Konkola deep mining project	180,000 copper. 3/
Do.	do. 4/	Nkana copper smelter	450,000 blister/anode.
Do.	do. 4/	Nkana copper refinery	236,000 blister/anode.
Do.	Mopani Copper Mines plc (Glencore International AG, 46%; First Quantum Minerals Ltd., 44%; ZCCM, 10%)	Mufalira Mine	2,800,000 ore.
Do.	do.	Mufalira concentrator	63,000 copper in concentrate.
Do.	do.	Mufalira smelter	130,000 copper.
Do.	do.	Mufalira refinery	150,000 copper.
Do.	do.	Nkana Mine	5,500,000 ore.
Do.	do.	Nkana concentrator	45,000 copper in concentrate; 1,900 cobalt in concentrate.
Do.	do.	Nkana cobalt plant	2,500 cobalt, refined; 15,000 copper.
Do.	Anglovaal Mining Ltd. (Avmin), 80%; ZCCM, 20%)	Konkola North project 5/	2,200,000 ore.
Do.	Chambishi Metals plc (Avmin, 90%; ZCCM, 10%)	Chambishi cobalt plant	4,000 cobalt.
Do.	do.	Nkana slag dump 6/	7,000 copper.
Do.	do.	UCHI tails retreatment plant	7,000,000 tailings feed.
Do.	First Quantum Minerals Ltd. (Canada), 100%.	Bwana Mkubwa Mine; SX-EW plant 7/	9,500 copper cathode.
Do.	Chibuluma Mines plc (Metorex Ltd., 85%; ZCCM, 15%)	Chibuluma West Mine 8/	450,000 ore; 8,400 contained copper; 100 contained cobalt.
Do.	do.	Chibuluma South Mine project 9/	18,000 copper. 3/
Do.	Roan Antelope Mining Corp. [Binani Group (India) 85%; ZCCM, 15%]	Luanshya underground mine	1,700,000 ore.
Do.	Roan Antelope Mining Corp.	Luanshya concentrator	23,000 copper in concentrate.
Do.	do.	Baluba underground mine	1,400,000 ore.
Do.	do.	Baluba concentrator	24,000 copper in concentrate; 1,900 cobalt in concentrate.
Do.	do.	Luanshya smelter 10/	20,000.
Do.	do.	Mulashi North project	34,000 copper; 1,400 cobalt. 3/
Do.	NFC Africa Mining plc (China Non-Ferrous Metals Industries, 85%; ZCCM, 15%)	Chambishi Mine 11/	45,000 copper. 12/
Do.	Cyprus Amax Kansanshi plc (United States), 80%; ZCCM, 15%)	Kansanshi Mine and environs 13/	NA.
Do.	Lumwana Joint Venture (Phelps Dodge Corp., 100%) 14/	Lumwana deposit 15/	75,000 copper. 16/
Do.	Qasim Mining Enterprises Ltd. (Colossal Resources Corp. of Vancouver, Canada, 60%)	Kabwe cobalt tails retreatment plant 17/	600 cobalt.
Do.	Orion Mining Zambia	Kabwe slag processing plant 18/	60,000 slag yielding 1,800 to 5,000 cobalt.
Gemstones: e/			
Amethyst kilograms	Vantage Enterprises Corp. (Canada) and various artisanal operations	Krystal Mine in Kaloma, Mumbwa, near Zimbabwean border	NA.
Aquamarine do.	Various artisanal operations	Katete and Petauke areas	NA.
Beryl do.	do.	Eastern Province pegmatites	NA.
Citrine do.	do.	Iteshi Teshi, Mumbwa	NA.
Emeralds do.	30 to 40 artisanal operations	Northwest of Kitwe	600.

See footnotes at end of table.

TABLE 2--Continued
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity 2/
Gemstones--Continued: e/				
Garnet	kilograms	Various artisanal operations	Eastern Province pegmatites, Mazabuka, Siavunga, Chikankata, Gwemba Valley	NA.
Tourmaline	do.	do.	Kalunga Wbeba Mine, Eastern Province; Hofmeyer Mine near Nyimba	NA.
Gold	do.	Reunion Mining plc (Anglo American plc, 100%)	Dunrobin Mine, 120 kilometers west of Lusaka	600.
Do.	do.	Minerva (PMP) Ltd. (Binani Group of India, 100%) 19/	Ndola precious metals plant	150 refined gold.
Lime	tons per day	Ndola Lime Co. Ltd. (ZCCM, 100%)	Ndola plants	1,000 limestone feed
Do.		do.	Ndola kiln	300,000 quicklime product.
Petroleum	42-gallon barrels	Zambia National Oil Co.	Indeni refinery at Ndola 20/	8,950,000 refined products.
Selenium	kilograms	Minerva (PMP) Ltd. (Binani Group of India, 100%)	Ndola precious metals plant	22,000 refined selenium.
Silver	do.	do.	do.	10,000 refined silver.
Sulfur 2/		Konkola Copper Mines plc [Zambia Copper Investments Ltd. (Anglo American plc), 65%; ZCCM, 20%; International Finance Corp., 7.5%; Commonwealth Development Corp., 7.5%]	Nampundwe pyrite mine	79,000 pyrite, 33,000 contained sulfur.
Do.		Chambishi Metals plc (Avmin, 90%; ZCCM, 10%)	Chambishi acid plant	65,000 sulfuric acid, 21,900 contained sulfur.
Do.		Mopani Copper Mines plc (Glencore International AG, 46%; First Quantum Minerals Ltd., 44%; ZCCM, 10%)	Nkana acid plant	120,000 sulfuric acid, 39,120 contained sulfur.
Do.		First Quantum Minerals Ltd. (Canada)	Bwana Mkubwa acid plant	110,000 sulfuric acid, 35,860 contained sulfur.

e/ Estimated. NA Not available.
1/ Includes data available through April 30, 2001.
2/ Some capacities shown, based on former Zambia Consolidated Copper Mines operations.
3/ Planned capacity.
4/ KCM has option to buy.
5/ Exploration and feasibility studies.
6/ Plant upgrade by 2001.
7/ Tailings retreament operation
8/ To close by 2003 or 2004
9/ To open by 2003 or 2004
10/ Closed.
11/ Closed in 1987.
12/ Planned capacity when plant reopens in late 2002.
13/ Mine closed in 1998; exploration continuing.
14/ Equinox Resources Ltd. of Australia can earn 50% to 75% interest.
15/ Exploration and prefeasibility work being conducted.
16/ Potential capacity.
17/ Closed in 1999.
18/ Plant to treat feed imported from Congo (Kinshasa).
19/ Processes copper refinery slimes.
20/ Damaged by fire in 1999.

THE MINERAL INDUSTRY OF

ZIMBABWE

By George J. Coakley

The Republic of Zimbabwe is a landlocked nation in southern Africa surrounded by Zambia to the north, Mozambique to the east, South Africa to the south, and Botswana to the west. It covers an area of 390,580 square kilometers (km^2) and supported a population of 11.34 million in 2000. For 1999 (the latest year for which data were available), the per capita gross domestic product was $2,400 based on 1999 purchasing power parity estimates. The mineral industry was diverse with more than 35 commodities produced from more than 1,000 mines, mostly small; the total value of mineral production exceeded $500[1] million per year and was equal to about 27% of export trade. An estimated 60,000 people are employed in mining. Gold was the most important commodity; output was valued at more than $194 million in 2000, which was down from $244 million in 1999 by value. Zimbabwe was a major contributor to the world supply of chrysotile asbestos, ferrochromium, and lithium minerals.

The year 2000 was a difficult one for Zimbabwe and its mining sector. The country had a second straight year of negative economic growth, high unemployment, a 60% inflation rate, and a decline in exports. The very high costs of domestic borrowing, a severe shortage of fuels and spare parts, and a foreign currency shortage had started to damage the operations and viability of the manufacturing and mining sectors severely, with several smaller mines forced to close during 2000. The Government's commitment of military support to the civil war in the Democratic Republic of the Congo [Congo (Kinshasa)] also was a sizable drain on extremely scarce national resources. The state-sanctioned involuntary expropriation of commercial farm lands threatened to spill over to the mining sector and sharply increased the political risk component of any new foreign investment (U.S. State Department, July 2000, Zimbabwe—Country commercial guide, accessed June 15, 2001, at URL http://www.state.gov/www/about_state/business/com_guides/2001/africa/zimbabwe_ccg2001.pdf).

In addition to economic and political difficulties, Zimbabwe had one of the highest incidences of HIV/AIDS infection in the world; 25% of the adult population between 15 and 49 years old was infected by the end of 1999. An estimated 160,000 deaths were attributed to AIDS in 1999, and since the beginning of the epidemic, more than 900,000 children have been orphaned (Joint United Nations Programme on HIV/AIDS, June 2000, Zimbabwe—Epidemiological fact sheet, accessed June 15, 2001, at URL http://www.unaids.org/hivaidsinfo/statistics/june00/fact_sheets/pdfs/zimbabwe.pdf). The HIV/AIDS epidemic has had a significant impact on mining by adding substantially to direct and indirect labor costs as a result of absenteeism, lost productivity, medical treatment, and skill replacement.

Production and Trade

Declines in production between 1999 and 2000 were significant (from 17% to more than 60%) in nine major commodities (table 1). These were chromite, coal, copper, diamond, gold, iron ore, nickel, phosphate, and silver. On the positive side, production increases from 4% to 36% were noted in antimony, asbestos, ferrosilicon, graphite, pig iron, lithium, platinum-group metals, crude steel, and vermiculite.

International Monetary Fund data for 1999 indicated that mineral and manufactured metal exports accounted for $550.8 million out of total exports of $1.92 billion for the year. Major exports included gold ($230 million), ferroalloys ($166.5 million), nickel ($48.1 million), asbestos ($35.8 million), and iron and steel ($12.5 million). Export earnings have been progressively declining since 1995 when a total of $736.6 million in minerals and manufactured metals were exported, although this can be attributed in part to declining commodity prices over this period. In 1999, imports of electricity and fuels, including petroleum products were valued at $301.1 million or 14% of total imports valued at $2.21 billion. On a basis of percentage of trade, South Africa, the United Kingdom, Germany, Japan, and the United States were Zimbabwe's major trading partners. South Africa supplied 40% of all imported goods (International Monetary Fund, January 2001, Zimbabwe—Recent economic developments—Selected issues and statistical appendix, IMF Country Report 01/13, accessed June 15, 2001, at URL http://www.imf.org/external/pubs/ft/scr/2001/cr0113.pdf).

Structure of the Mineral Industry

All mining activities come under the Mines and Minerals Act (Chapter 165) (1961), amendments, and associated regulations. The Ministry of Mining, Environment, and Tourism is responsible for the mining sector. All mineral rights are vested in the state through the President of Zimbabwe. Investment projects are sanctioned by the Zimbabwe Investment Center. The Gold Trade Act gives the Reserve Bank of Zimbabwe a monopoly on purchasing and exporting all gold and silver produced in Zimbabwe. Minerals Marketing Corp. of Zimbabwe is responsible for marketing all other minerals and metal products for a commission of 0.875% of sales handled.

The state-owned mining company, Zimbabwe Mining Development Corp. (ZMDC), has an interest in a number of mining operations, conducts exploration and mining, and provides assistance to small-scale miners. The state-owned Industrial Development Corp. of Zimbabwe Ltd. has several subsidiary companies that operate in the industrial mineral sector.

Zimbabwe has a significant local mining industry. More than 500 gold mining operations are registered. Production from the large mines of Ashanti Goldfields Co. Ltd. of Ghana, Kinross

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[1] Where necessary, values have been converted from Zimbabwe dollars (Z$) to U.S. dollars at the average exchange rate of Z$44.44=US$1.00 in 2000 and Z$38.31=US$1.00 in 1999.

Gold Corp. of Canada, Lonrho Zimbabwe Ltd., and Rio Tinto Zimbabwe Ltd. dominate the gold sector, but the numerous medium- and small-scale producers contribute about 10% to the nation's formal gold production. Alluvial gold panning is Zimbabwe's rural alternative to subsistence farming. The Mining (Alluvial Gold) (Public Streams) Regulations (1991) authorize selective alluvial gold mining, but extensive riverbank erosion and stream siltation have resulted from uncontrolled mining activity. National Oil Co. of Zimbabwe (Noczim) is run as a state monopoly that constrains competition and free market pricing.

Commodity Review

Metals

Chromite.—Zimbabwe Mining and Smelting Company Private Ltd. (Zimasco) produced 621,305 metric tons (t) of chromite, which was an increase of 5% compared with that of 1999. Zimbabwe Alloys Ltd. (Zimalloys), which was the other major producer, produced 104, 053 t of chromite in 2000 compared with 49,943 t in 1999. Because of operating problems at its Inyala Mine since 1999, Zimalloys bought from 50% to 75% of its chromite ore feed for its ferroalloys plant from local independent miners (Robertson Economic Information Services, 2001, Mining tables—Zimbabwe's mine and mineral production figures, accessed January 15, 2002, at URL http://www.economic.co.zw/mining/tables/production.htm).

Copper.—Mhangura Copper Mines (owned by ZMDC) was near depletion and had been relying on an uncertain supply of toll concentrates to stay alive. The failure of the national copper company of Congo (Kinshasa) La Générale des Carrières et des Mines to honor a contract to supply 3,000 metric tons per month (t/mo) of copper concentrates to the Mhangura smelter further jeopardized operations (African Energy & Mining, 2000). After operating at a loss for 1999 and most of 2000, the mine was placed on a care-and-maintenance status, and 400 workers were laid off late in the year (Metal Bulletin, 2000b).

Munyati Copper Mines Ltd. was owned by Reunion Mining plc (75%) and ZMDC (25%) and produced at a rate of about 72,000 metric tons per year (t/yr) of contained copper. In March 2000, Munyati suspended operations following the withdrawal of Anglo American plc, which had acquired Reunion Mining in 1999, from the partnership. ZMDC was seeking a new partner to reopen the mine (Herald [Harare], July 3, 2000, ZMDC seeking strategic partner in Munyati Mines, August 16, 2000, accessed July 1, 2001, at URL http://qzwhre.africaonline.co.zw/herald/full.asp?articleid=3104&issue=303).

Gold.—The gold sector was one the most affected sectors of the industrial economy in 2000—three major mines and several small operations, which included the Connemara, the Eureka, and the Venice Mines, closed. All gold must be sold to the central Reserve Bank of Zimbabwe with payment in local currency at a fixed rate, which was lower than the rate at which the companies could buy foreign exchange. This has put the gold sector at a disadvantage to other companies whose commodities which can be exported for hard currency. For the first time in 20 years, gold production declined to 22.1 t in 2000 from 27.7 t in 1999.

In 2000, Ashanti Goldfields Co. Ltd. of Ghana produced a record 3,489 kilograms (kg) of gold at the Freda-Rebecca Mine compared with 3,396 kg in 1999. Underground production totaled 1.04 million metric tons (Mt) of ore at a head grade of 3.69 grams per metric ton (g/t) gold. Processed tonnage for 2000 was 1 Mt at a grade of 3.89 g/t gold with a recovery rate of 89.8% gold. The operation successfully recovered from a strike in February and mechanical failures at two semi-autogenous grinding mills despite problems with the lack of foreign exchange and the fixed exchange rate coupled with high inflation. Ashanti reported remaining measured and indicated mineral resources at Freda-Rebecca to be 15.8 Mt at a grade of 2.6 g/t gold, of which 5.8 Mt at a grade of 2.4 g/t gold was in the proved and probable ore reserve category. Ashanti was also exploring the RAN gold-copper property 5 kilometers (km) east of its Freda-Rebecca Mine (Ashanti Goldfields Co. Ltd., March 2001, Ashanti Goldfields Co. Ltd. annual report for 2000, accessed July, 1, 2001, at URL http://www.ashantigold.com/download/ashanti2000annualreport.pdf).

In 1998, Battlefield Minerals Corp. of Canada invested $425,000 to install a 720,000-t/yr carbon-in-pulp processing plant to treat tailings and open pit oxide ore at the Pickstone-Peerless gold mine. Production was at a rate of 622 kg of gold in 1999 from tailings and was forecast to be increased to 933 kg of gold with the subsequent startup of oxide mine production in 2000, which did not occur. Following operating losses from the tailings operation in the first half of 2000, Battlefield transferred title to 64 mining claims in the Pickstone-Peerless area to UDC Holdings Limited for sale by public tender in exchange for partial cancellation of Battlefield's indebtedness to UDC Holdings (Battlefield Minerals Corp., August 29, 2000, Battlefield transfers title to 64 mining claims to UDC, accessed July 5, 2001, at URL http://www.infomine.com/index/pr/Pa051770.PDF).

Casmyn Corp. of the United States, which owned the Turk Mine and 18 other smaller gold mines, filed for bankruptcy in late 1999. In April 2000, the U.S. Bankruptcy Court approved its reorganization plan, and the company was subsequently reincorporated as Aries Ventures, Inc. (Aries Ventures, Inc., 2000, Aries Ventures—Key developments, accessed July 2, 2001, at URL http://www.business.com/directory/industrial_goods_and_services/materials/mining_and_minerals/minerals/aries_ventures/key_developments).

Cluff Mining plc acquired the Maligreen gold deposit located approximately 240 km southwest of Harare and other surrounding claims totaling 326 km² from Reunion Mining plc in July 1999. A gold resource of 2.6 Mt at a grade of 4.5 g/t gold was calculated by Reunion. During 2000, Cluff entered into a joint venture with Pan African Mining (Private) Limited whereby Pan African earned a 50% interest in the deposit by bringing the mine into production. First gold was poured in August 2000, and the mine attained full production during October 2000. A total of 18,346 t of oxide ore at a grade of 5.55 g/t gold was processed through the heap-leach and vat-leach facilities during the fourth quarter of 2000; gold production for the quarter totaled 101 kg. Exploration was ongoing to extend the life of the oxide resource from 2000 to 2001. Construction of further facilities for the treatment of the underlying sulfide resources was under consideration (Cluff Mining plc, July 2, 2001, Zimbabwe—Maligreen, accessed July 6, 2001, at URL http://www.cluff-mining.com).

Delta Gold Zimbabwe (Pvt.) Ltd. (100%) commissioned the processing plant at its $25 million Eureka gold project in December 1999 as scheduled. Unable to operate under the economic conditions prevailing in Zimbabwe, Delta suspended operations in June 2000 and placed the Eureka Mine on a care-and-maintenance basis until conditions improved (Delta Gold Ltd., 2001, Operations—Eureka, accessed July 6, 2001, at URL http://www.deltagold.com.au).

Falcon Gold Zimbabwe Ltd. (a subsidiary of Falcon Investments S.A. of Luxembourg) closed the Venice Mine and continued operations at the Dalny and the Golden Quarry Mines where production totaled 1,300 kg of gold in 2000. Consolidated Trillion Resources Ltd. of Canada sold its 50% interest in the Jena gold mine to its partner ZMDC and put its Ndarama gold mine up for sale. Total resources at the Jena Mine were estimated to be 1.7 Mt at a grade of 4.7 g/t gold; the mine produced more than 466 kg of gold in 1999 (Mbendi Information Services, May 15, 2001, Zimbabwe—Mining—Gold mining, accessed July 6, 2001, at URL http://www.mbendi.co.za/indy/ming/gold/af/zi/p0005.htm).

In August 2000, First Quantum Minerals Ltd. suspended operations at its Connemara gold mine pending an improvement in the economic fundamentals in Zimbabwe. Minimum staffing levels would be maintained to complete leaching of current ore pads and to ensure the integrity of the Connemara assets. The mine produced 671 kg of gold in 1999 from 663,200 t of ore at a grade of 2 g/t gold. Remaining resources at yearend 1999 were estimated to be 6.5 Mt at a grade of 2.43 g/t gold, of which 3.5 Mt at a grade of 2.53 g/t gold was in the reserves category (First Quantum Minerals Ltd., 2001, Gold operations—Connemara gold mine, accessed July 2, 2001, at URL http://www.first-quantum.com).

Kinross Gold Corp. of Canada owned (100%) and operated the Blanket underground gold mine and tailings-retreatment facility in the southwestern portion of the country. During 2000, the mill processed 208,350 t of underground ore at an average grade of 3.98 g/t gold and 497,450 t of tailings at an average grade of 1.11 g/t gold compared with 205,300 t and 1.04 Mt, respectively, in 1999. Gold production was 1,075 kg compared with 1,174 kg in 1999. The company was continuing with underground haulage development and shaft sinking in the Eroica ore zone during 2001 (Kinross Gold Corp., 2001, Operations—Mining—Blanket, accessed July 2, 2001, at URL http://www.kinross.com/op/min/bla.htm).

Lonmin plc of the United Kingdom operated six gold mines during 2000—Arcturus, How, Mazowe, Muriel, Redwing, and Shamva; the Tiger Reef Mine was sold in June. Production declined nominally to 5,879 kg of gold in 2000 from 6,003 kg in 1999; Lonmin noted that cash operating costs were highly distorted and increased by 40% to $260 per ounce owing to the prevailing macroeconomic conditions. Proved and probable underground reserves as of June 30, 2000, and based on a gold price of $280 per ounce were reported to contain more than 28,900 kg of gold at an average grade of 6.1 g/t gold. Exploration during 1999 and 2000 highlighted the expansion potential of the How and the Shamva Mines, in particular (Lonmin plc, Annual review for 2000, accessed July 6, 2001, at URL http://www.lonmin.com/files/Lonmin2000_Annual_Review.pdf).

Rio Tinto Zimbabwe had a 56% interest in and operated the Renco and the Patchway underground gold mines and the Cam dump gold retreatment plant. Total gold production in 2000 was 2,190 kg, which was only 1% less than that of 1999. Total underground reserves were reported to be 300,000 t at a grade of 9.49 g/t gold (Rio Tinto plc, 2001, Annual report for 2000, accessed July 5, 2001, at URL http://www.riotinto.com/library/Publications/AnnualReport.pdf).

Ferroalloys.—Zimalloys produced 24,967 t of ferrochrome and 19,631 t of ferrosilicon in 2000 compared with 32,902 t and 16,267 t, respectively, in 1999. Zimalloys, in which the Japanese companies Japan Metals and Chemicals Co. Ltd. and Mitsui and Co. Ltd. each held a 25% interest, operated a 40,000-t/yr low-carbon ferrochrome plant at Gweru. Affected by internal economic conditions and by weak world markets, Zimalloys suspended operations for 2 months during 2000. Zimasco, which was the largest ferrochrome producer, increased its output by 5% in 2000 to 221,357 t (Robertson Economic Information Services, 2001, Mining tables—Zimbabwe's mine and mineral production figures, accessed January 15, 2002, at URL http://www.economic.co.zw/mining/tables/production.htm).

Iron and Steel.—In an apparent effort to privatize its 83% ownership of the steel sector, the Government invited three companies—Ferrostaal AG of Germany, Shougang Corp. of China, and Voest-Alpine of Austria—that were involved in the rehabilitation of Zimbabwe Iron and Steel Co. (Zisco) to become equity partners in Zisco. Rehabilitation work has included refurbishment of blast furnace no. 4 and modernization of the 160,000-t/yr continuous bar and rod mill (Metal Bulletin, 2000a). The Zisco plant had the capacity to produce 800,000 t/yr of crude steel. Iron ore output in 2000 was 450,636 t.

Nickel.—Bindura Nickel Corp. (BNC) [owned by Anglo American (53.1%)] operated the Madziwa, the Trojan, and the Shangani nickel mines; a nickel smelter; and a nickel refinery. The Madziwa mine was closed down at yearend 2000. The Trojan and the Shangani mines had remaining mine lives of 14 and 5 years, respectively. Combined measured and indicated resources at BNC were estimated to be 12.3 Mt at a grade of 0.64% nickel, of which 1.9 Mt at grade of 0.56% nickel was classified as ore reserves (Anglo American plc, March 13, 2001, Annual report, accessed July 2, 2000, at URL http://www.angloamerican.co.uk/documents_v1/annualin/2000_ann/Report2000). Bindura Smelting & Refinery Ltd. produced 6,693 t of nickel from ore from its mines in Zimbabwe. Rio Tinto Zimbabwe, which operated the Empress nickel refinery that processed matte supplied from Botswana on a toll basis, toll refined 6,940 t nickel in 2000.

Platinum-Group Metals.—Compared with 1998 when the Hartley Mine was in full operation, national platinum-group metals (PGM) production in 2000 declined by around 80% to 366 kg of platinum, 505 kg of palladium, and 40 kg of rhodium. The only operating mine in 2000 was Zimasco's Mimosa Mine at the southern end of the Great Dyke. During 1999, BHP Minerals Zimbabwe (a subsidiary of BHP Ltd. of Australia) closed down the Hartley platinum complex and sold its 67% interest to Zimbabwe Platinum Mines Ltd. (Zimplats) for $3 million, along with its interest in the Mhondoro platinum project. Zimplats now controls all of the PGM assets in the Hartley, Ngezi, Mhondoro and Selous areas, with total resources estimated at 9.7 million kilograms (Mkg) of PGM (three platinum-group elements plus gold), of which 5.1 Mkg was platinum (Zimbabwe Platinum Mines Ltd., 2001, Company overview, accessed June 29, 2001, at URL http://www.zimplats.com/documents/overview.htm).

Zimplats [owned by Delta Gold (51%)] continued to seek financing for its new $48 million Ngezi platinum project. The project would truck 180,000 t/mo of ore from a new open pit mine at Ngezi South, 77 km north to the Selous Metallurgical Complex at the closed Hartley Mine. The project would produce 3,350 kilograms per year (kg/yr) of platinum, 2,550 kg/yr of palladium, 250 kg/yr of rhodium, 370 kg/yr of gold, and minor byproduct nickel and copper. Subject to financing and the final transfer of BHP assets to Zimplats, construction on the project was expected to begin by mid-2001 (Tessel, 2001).

In September, Anglo American Corp. put a hold on investment in its proposed $70 million Unki Project near Shurugwi. The project would produce 3,670 kg/yr of PGM and 2,500 t/yr of copper and nickel (Darren Schuettler, Barney Online News, September 28, 2000, Anglo says eroding confidence halts Zim investment, accessed September 29, 2000, at URL http://www.barney.co.za/reuters/sep00/anglo28.htm).

Uranium.—Licon Mines (Pvt.) Inc. owned the rights to the Kanyemba sandstone uranium-vanadium deposit in the northeastern part of the country. The company was owned equally by Cassiar Mines and Metals Inc. (formerly Minroc Mines Inc.) and Cline Mining Corp., both of Canada. On the basis of Licon's 1998 estimate, $20 million would be required to develop an underground mine and processing facility to produce 453,600 kg/yr of uranium oxide and 793,800 kg/yr of vanadium oxide (Cassiar Mines and Metals Inc., September 8, 1998, Minroc acquires new uranium project, accessed July 2, 2001, at URL http://www.cassiarmagnesium.com/press.htm). A $3 million feasibility study began in 1999 and continued in 2000. Cassiar indicated in its 1999 annual report that a separate company would be incorporated in Canada to develop the Kanyemba project and that Cassiar would focus its efforts on a major magnesium development in northern British Columbia. Cline reported that resources have been calculated at 14 pounds per metric ton [7 kilograms per metric ton (kg/t)] of uranium oxide and 30 pounds per ton (15 kg/t) of vanadium oxide and that drilling through 2000 had identified 7 million pounds (3.2 Mkg) of uranium oxide and 15 million pounds (6.8 Mkg) of vanadium oxide. The companies will continue to refine the feasibility studies while awaiting an upturn in world uranium markets (Cline Mining Corp., April 2001, Annual report 2000, accessed July 6, 2001, at URL http://www.sedar.com/csfsprod/data24/filings/00347637/00000001/f:%5CDATA2%5CSEDAR%5C39527%5C2001agm%5CAnReport.pdf).

Industrial Minerals

Asbestos.—African Associated Mines (Pvt.) Ltd. produced chrysotile asbestos from its Gaths and Shabanie Mines and employed about 6,000 people. Production in 2000 was 145,203 t of asbestos valued at $60 million (Robertson Economic Information Services, 2001, Mining tables—Zimbabwe's mine and mineral production figures, accessed January 15, 2002, at URL http://www.economic.co.zw/mining/tables/production.htm).

Cement.—Cement production and sales were down for 2000 because as fuel shortages and heavy rains had a negative effect on construction. Portland Holdings Ltd. through United Portland Cement Manufacturing operated an 11-year-old cement plant at Bulawayo with the capacity to produce 420,000 t/yr. The 60-year-old cement clinker kiln with a capacity of 300,000 t/yr at Colleen Bawn was closed in 2000. Portland Holdings produced 743,700 t of cement in 1999 and 250,600 t during the first half of 2000. Circle Cement Ltd. was the other major producer out of Harare. The two companies had the capacity to produce about 1.44 million metric tons per year of cement, which was about 91% of internal demand. The Government's Industry and Trade Competitive Commission issued a report in which the two main companies were charged with restrictive trade practices that it claimed were creating distortions in supply and distribution of cement (Financial Gazette, April 6, 2000, Probe into cement industry reveals unfair practices, accessed May 22, 2000, at URL http://www.cyberplexafrica.com/fingaz/99/stage/archive/000405/companies17336.html).

In May, a consortium of local and foreign investors, which were incorporated as Gocha Cement Corp., announced plans to invest more than $110 million to build a new cement plant with a capacity of 730,000 t/yr of cement, primarily for local export, in Masvingo (Financial Gazette, May 18, 2000, Group to build cement plant in Masvingo, accessed May 22, 2000, at URL http://www.fingaz.co.zw//99/stage/archive/000517/companies4162.html). A smaller 270,000-t/yr cement plant, which was built by Chinese Building Materials Corp. and the state-owned Industrial Development for $45 million in Lalapanzi, was scheduled to be operational by September (Herald, 2000).

Diamond.— Rio Tinto Zimbabwe and Trans Hex International Ltd. were actively exploring for kimberlites in an area bordering the Limpopo River, east of Beit Bridge.

Granite.—Zimrock International (Pvt.) Ltd. (a Stone Holdings Group subsidiary) operated a granite cutting and polishing facility at Ruwe that was supplied with granite from the Mutoko Quarry. Stone Holdings was owned by the Marlin Corp. of South Africa (51%) and the Industrial Development (49%). Exports of polished granite to markets in Africa and Europe were expected to reach $100 million in 2000 (Financial Gazette, February 24, 2000, Ruwa-based granite firm expects US$100 million from exports, access May 22, 2000, at URL http://www.fingaz.co.zw//99/stage/archive/000223/companies749.html).

Mineral Fuels

Coal.—Wankie Colliery Co. Ltd. operated the country's only coal mine near Hwange. In 2000, production declined by 17% to 3.8 Mt and was valued at about $58 million. The Government was seeking buyers for its 40% interest in Wankie. Its two main customers were Zisco and the Zimbabwe Electric Supply Authority powerplant at Hwange. Rio Tinto Zimbabwe was conducting a feasibility study on developing the Gokwe North Coal project which would support a new 350-megawatt coal-fired powerplant to be built by the Government (Mbendi Information Services, May 15, 2001, Zimbabwe—Mining—Coal mining, accessed July 6, 2001, at URL http://www.mbendi.co.za/indy/ming/coal/af/zi/p0005.htm).

Petroleum.—Faced with continuing financial problems and heavy indebtedness to electricity suppliers in Mozambique and South Africa that resulted in severe fuel shortages, the

Government announced its intention in November to end Noczim's monopoly on purchasing imported oil products. Noczim's role will be changed to that of a manager of a national strategic oil reserve. A new agency, the Single Procurement Agency, will be set up to increase the participation and competition among independent oil companies and buyers. During future shortages the Single Procurement Agency would buy oil from Noczim's strategic reserves for onward sale to oil companies (African Energy Intelligence, 2000). Fuel shortages were also driving up the demand for firewood as a fuel substitute and adding to deforestation and pollution problems.

Infrastructure

Most of landlocked Zimbabwe's bulk commodities were moved by rail on the state-owned National Railways of Zimbabwe (NRZ). All major cities and industrial centers were linked to Botswana, Mozambique, South Africa, and Zambia by the NRZ. Petroleum products were piped through Mozambique via the Beira pipeline to Feruka and then moved west via the Mutare-Harare pipeline or trucked on Zimbabwe's 85,784-km road network. Additional petroleum products were imported via railroad tanker cars through South Africa.

Outlook

The short-term outlook for the mining sector was not favorable. Excess Government intervention in the economy and in state-run industries has been a major contributor to the growing number of closed mines and suspended projects that are undermining the ability of the mining sectors to continue to generate more than 25% of Zimbabwe's foreign export earnings. External market forces and weak commodity prices have also had a serious impact on ferroalloys, gold, steel, and uranium developments. On the more positive side, Government efforts to privatize its interests in the energy, mining, and rail sectors and to loosen its foreign exchange rules should stimulate the economy and open competition and entrepreneurship. The natural resource endowment and a well-developed infrastructure remain in place. Officials are optimistic that in the longer term, mineral development will return to its key role in the economy.

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Major Sources of Information

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Fax: (263) (4) 739-601
E-mail: zimgeosv@africaonline.co.zw

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Bartholomew, D.S., 1990, Base metal and industrial mineral deposits of Zimbabwe: Harare, Zimbabwe Geological Survey Mineral Resources Series No. 22, 154 p.

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TABLE 1
ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 e/
METALS						
Antimony, mine output, concentrate, Sb content		5	--	--	--	--
Chromite, gross weight	thousand tons	697	670 e/	605	641 3/	725 3/
Cobalt, metal 4/		106 3/	126	138	121 3/	126 3/
Copper:						
Mine output, concentrate, Cu content		10,000 e/	9,000 e/	6,000 r/ e/	4,511	2,104
Metal:						
Smelter output, blister/anode, primary e/		18,000 r/	18,000 r/	10,000 r/	10,000 r/	10,000
Refinery output, refined/cathode, primary		15,100 r/	13,000 r/	11,000 r/	10,000 r/	10,200

See footnotes at end of table.

TABLE 1--Continued
ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 e/
Gold	kilograms	24,699	24,156	25,175 r/	27,666 3/	22,070 3/
Iron and steel:						
Mine output, iron ore:						
Gross weight	thousand tons	324	479 r/	372 r/	599	451 3/
Fe content e/	do.	160	240	190	300	225 3/
Metal:						
Pig iron e/	do.	210	216	230	230	240
Steel, crude	do.	212	214	220	255 r/	269 3/
Ferroalloys:						
Ferrochromium	do.	243	233	247	244 r/	246 3/
Ferrosilicon chromium	do.	33	17	21	16 r/	20
Nickel:						
Mine output, concentrate, Ni content		11,561	12,963	12,872	11,164	8,160
Refinery output, refined metal		9,694	10,300 5/	8,732	9,137 r/	6,693 3/
Platinum-group metals:						
Palladium	kilograms	120 e/	245	1,855	342	366 3/
Platinum	do.	100 e/	345	2,730	479	505 3/
Rhodium	do.	-- e/	27	177	37 r/	40
Selenium e/	do.	2,000	1,000	500	500	500
Silver	do.	9,982	5,923	6,681	5,181 r/	3,536 3/
Tin, mine output, Sn content e/		10	10	1	1	1
INDUSTRIAL MINERALS						
Asbestos	thousand tons	165	145	123	115	145 3/
Barite		-- e/	1,217	1,844	1,000 e/	1,000
Cement, hydraulic e/	thousand tons	1,000	1,100	1,100	1,000	1,000
Clays:						
Bentonite (montmorillonite)		185,953 r/	186,000 e/	135,785	140,000 e/	140,000
Other clays 6/		14,479	14,000 e/	2,818	3,000 e/	3,000
Diamond	carats	437,266	421,307	28,732	45,324	16,678 3/
Emerald	kilograms	1,080	1,000 e/	19	20	20
Feldspar		3,248	2,254	2,241	2,250	2,200
Graphite		7,691	12,779	13,806	11,405 r/	11,812 3/
Kyanite		141	1,113	3,780	4,000 e/	4,000
Lithium minerals, gross weight		30,929	49,833	28,055	36,671	41,957 3/
Magnesite		10,659	13,050	4,321	4,000 e/	4,000
Mica		1,500	30	1,309	1,300	1,300
Nitrogen, N content of ammonia e/		61,400	63,700	56,500	60,800 3/	58,400 3/
Phosphate rock, marketable concentrate	thousand tons	123	94	91	126 r/	110
Pigments, iron oxide		400 e/	-- e/	--	--	--
Stone, sand and gravel:						
Granite		109,268	109,903	125,576	130,000 e/	130,000
Limestone	thousand tons	1,425	1,027	1,473	1,500 e/	1,500
Quartz 7/	do.	96	52	10	10 e/	10
Sulfur						
Pyrite:						
Gross weight		59,831	48,101	52,908	48,793 r/	66,032
S content (32.6%)		19,500 r/	15,700 r/	15,250 r/	15,900 r/	21,500
Byproduct acid, metallurgical and coal process gas e/		5,000	5,000	2,500	2,500	2,500
Talc		1,076	1,023	1,039	1,000 e/	1,000
Vermiculite		10,249	14,841	14,804	13,898 r/	18,935
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	5,175	4,750	5,047	4,576 r/	3,808 3/
Coke, metallurgical e/	do.	600	600	600	600	600

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through June 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ Reported figure.

4/ "Metal" includes metal content of compounds/salts and may include cobalt recovered from nickel-copper matte imported for toll refining.

5/ Excludes toll refined nickel.

6/ Includes fire clay.

7/ Includes rough and ground quartz, as well as silica sand.

THE MINERAL INDUSTRIES OF

THE MIDDLE EAST

By Philip M. Mobbs and Thomas R. Yager

The production and processing of crude petroleum and natural gas were the dominant segments of the economies of many of the nations of the Middle East covered in this section. The surge of international crude oil prices during 2000 financially benefited the major oil-producing countries (table 1).

The Middle East region contains an estimated population of 231 million people in an area of 9.7 million square kilometers compared with a population of 282 million people in an area of 9.2 million square kilometers for the United States. The gross domestic product of the Middle East region was estimated to be $789 billion in 2000 compared with $10 trillion for the United States and $31 trillion for the world.

Trade

In 2000, the United States imported 3.3 billion barrels of crude oil, of which the Middle East region supplied about 27%. Saudi Arabia, which was the leading supplier, provided 556 million barrels (Mbbl), or 17% of the United States' crude oil imports. Iraq, with exports of 226 Mbbl to the United States, jumped to 6th place on the list of the largest crude oil suppliers to the United States, whereas Kuwait, which was the source of 96 Mbbl crude oil imports, dropped to 11th on the list (U.S. Energy Information Administration, 2001).

Exploration Highlights

Industrial mineral and metal exploration activity was concentrated in Iran and Turkey (D.R. Wilburn, U.S. Geological Survey, written commun., 2001). Exploration and evaluation operations included prospecting for base and precious metals in Cyprus, Iran, Oman, Saudi Arabia, Turkey, and Yemen. Hydrocarbon exploration continued in Bahrain, Iran, Iraq, Israel, Jordan, Oman, Qatar, Saudi Arabia, Syria, Turkey, the United Arab Emirates, and Yemen. Cyprus initiated discussions with Egypt concerning the possible extension of Egyptian natural gas reservoirs into the Cypriot exclusive economic zone and the allocation of any recovered natural gas.

Mineral Operations Update

In 2000, Aluminium Bahrain B.S.C. continued construction of a coke-calcining plant. Bahrain Petroleum Co., B.S.C. (closed), continued the upgrade of its oil refinery at Sitra, Bahrain. In Israel, Dead Sea Works Ltd. completed the expansion of its potash production capacity, and Hakurnas Lead Works Ltd. doubled the capacity of its lead plant. The construction of Jordan Bromine Co. Ltd.'s bromine plant and Jordan Magnesia Co.'s magnesia plant was underway in Jordan. Oman Liquefied Natural Gas L.L.C.'s liquified natural gas (LNG) plant came online at Qalhat, Oman, and Ras Laffan Liquefied Natural Gas Co.'s second LNG train came online at Ras Laffan, Qatar. Saudi Arabian Fertilizer Co. began production at its third ammonia and urea plant. In the United Arab Emirates, the expansion of the Ruwais oil refinery of Abu Dhabi Oil Refining Co. was completed.

Outlook

In a number of nations in the region, high prices received for exported crude oil and petroleum products during 2000 allowed Governments to earmark funds for the development or reevaluation of a number of deferred mineral industry projects. Ammonia and urea plant expansions were proposed in Iran, Kuwait, Oman, Qatar, and Saudi Arabia; expansion of cement production capacities, in Iran and Kuwait; LNG projects, in Qatar and Yemen; new oil refineries, in Oman, Syria, and Yemen; and renovation of the Larnaca oil refinery, in Cyprus. Other proposed projects in the region included the development of a chromite mine, copper mines, ferrochrome plants, ferrosilicon plants, a direct-reduced iron plant, a zinc smelter, and steel plant and zinc smelter expansions in Iran; the construction of an aluminum smelter in Oman; and the development of the Az Zabirah bauxite, the Al Jalamid phosphate, and the Zaghat magnesite deposits in Saudi Arabia. Any significant decline in world oil prices would result in reduced Government income and could result in the suspension of progress on many of the diversified mineral projects listed above.

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TABLE 1
MIDDLE EAST: PRODUCTION OF SELECTED MINERAL COMMODITIES IN 2000 1/ 2/

(Thousand metric tons unless otherwise specified)

Country	Aluminum e/	Boron	Cement, hydraulic e/	Chromite	Copper, mine Cu content	Gypsum e/	Natural gas	
							Plant liquids (thousand 42-gallon barrels)	Dry (million cubic meters)
Bahrain	509 3/	--	89 3/	--	--	--	3,636	8,966
Cyprus	--	--	1,398 3/	--	11	138 3/	--	--
Iran	140	4	23,880 3/	310 4/	138	11,000	25,000	55,000
Iraq	--	--	2,000	--	--	--	4,000	3,000
Israel	--	--	6,600	--	--	46	--	9
Jordan	--	--	2,640 3/	--	--	158 3/	--	287
Kuwait	--	--	2,000	--	--	--	38,000	9,500
Lebanon	--	--	3,200	--	--	2	--	--
Oman	--	--	1,720	15	--	132 3/	6,000	8,000
Qatar	--	--	1,050	--	--	--	22,000	26,000
Saudi Arabia	--	--	18,107 3/	--	1 e/	400	285,008	58,870
Syria	--	--	4,830	--	--	363	3,000 e/	6,200 e/
Turkey	60	1,450	35,825 3/	546	76 e/	303 3/	--	612
United Arab Emirates	470	--	6,100	60 e/	--	90	110,000	39,000
Yemen	--	--	1,400	--	--	100	2,400	--
Total Middle East 5/	1,180	1,450	111,000	930	226	12,700	499,000	215,000
Total world	24,000	4,220	1,640,000	14,400	13,200	106,000	2,250,000 e/	2,420,000
Share of world total, percentage	5	34	7	6	2	12	22	9
United States	3,668 3/	1,070	89,510 3/	--	1,440	19,500 3/	698,000 e/	555,600

Country	Nitrogen, N in ammonia	Petroleum, crude (thousand 42-gallon barrels) 6/	Phosphate rock e/ (gross weight)	Potash, K2O equivalent e/	Salt e/	Steel, crude e/	Sulfur e/
Bahrain	350	13,766	--	--	--	--	66
Cyprus	--	--	--	--	--	--	--
Iran	965	1,360,000	--	--	1,600	6,600	1,350
Iraq	220 e/	930,000	1,000	--	300	200	250
Israel	--	32 e/	4,110 7/	1,710	863	285	31
Jordan	--	--	5,458 3/	1,160	311 3/	-- 3/	--
Kuwait	410	800,000	--	--	100	--	600
Lebanon	--	--	--	--	4	--	--
Oman	--	330,000 e/	--	--	--	--	30
Qatar	1,097	254,000 e/	--	--	--	729 3/	150
Saudi Arabia	1,743	3,360,000	--	--	200	2,973 3/	2,101 3/
Syria	91	194	2,166 3/	--	150	70	30
Turkey	53 e/	19,783	--	--	2,126 3/	14,325 3/	200
United Arab Emirates	384	900,000 e/	--	--	--	--	1,120 3/
Yemen	--	167,000 e/	--	--	150	--	--
Total Middle East 5/	5,310 e/	8,130,000	12,700	2,870	5,800	25,200	5,900
Total world	109,000	28,100,000	133,000	25,400	214,000	846,000	57,200
Share of world total, percentage	5	29	10	11	3	3	10
United States	12,300 8/	3,306,000	38,600 3/	1,300	45,600 9/	102,000	10,300 3/

e/ Estimated. -- Zero.

1/ Table includes data available through October 31, 2001.

2/ Data may be different from that appearing in individual country production tables owing to availability of more current data.

3/ Reported figure.

4/ Concentrate.

5/ May not add to totals shown because of independent rounding.

6/ Includes lease condensate.

7/ Beneficiated.

8/ Synthetic anhydrous ammonia; excludes coke oven byproduct ammonia.

9/ Includes Puerto Rico.

TABLE 2
SELECTED MIDDLE EAST EXPLORATION ACTIVITY IN 2000

Country	Prospect	Commodity	Companies	Resource notes 1/	Exploration notes
Cyprus	Alestos	Gold	Eastern Mediterranean Minerals (Cyprus) Ltd.	NA	Completed rock chip sampling and preliminary drilling programs.
Do.	Klirou	Zinc, copper, gold	do.	420,000 metric tons grading 1.3% zinc, 1.1% copper, and 1 gram per metric ton gold	Reprocessed geophysical data.
Do.	Red Hills	Gold	do.	NA	Completed preliminary drilling program.
Do.	Shia-New Shia-Mathiatis	Copper, zinc, gold	do.	do.	Completed airborne geophysics, stream geochemistry survey, and preliminary drilling program.
Iran	Agh Darreh	Gold	Minerals Exporting Co. of Iran and Zarcan Minerals Inc.	5.2 million metric tons grading 4.68 grams per metric ton gold	Prefeasibility study and phase I (159 holes, 6,643.6 meters) of a 2-year reverse circulation drill program completed in 2000.
Do.	Kuh-e-Lar	Copper, gold, molybdenum	National Iranian Copper Industries Co. and Zarcan Minerals Inc.	NA	Twenty nine hole reverse circulation drilling and reconnaissance rock sampling programs underway in 2000.
Do.	Mediabad	Zinc, lead, silver	Iran Mines and Mineral Industry Development and Renovation Organization, Itok GmbH, and Union Capital Ltd.	217.9 million metric tons grading 7.2% zinc, 2.34% lead, and 51 grams per metric ton gold	Prefeasibility study underway.
Oman	Ghuzayn	Copper	Metal Mining Agency Japan	NA	Continued exploration proposed.
Do.	Washihi	Copper, gold	National Mining Co.	3.35 million metric tons grading 0.79% copper and 0.29 grams per metric ton gold	Do.
Saudi Arabia	Bulghah	Gold	Saudi Company for Precious Metals	33 million metric tons grading 1.1 grams per metric ton gold	Completed feasibility study.
Turkey	Cukurdere	Copper, gold	Anatolia Minerals Development Ltd. and Rio Tinto Mining & Exploration Ltd.	NA	Channel sampling program completed. Drilling program proposed.
Do.	Efemcukuru	Gold	Tuprag Metal Madencilik San. Ve Tic. Ltd. Sti.	2.5 million metric tons grading 13.71 grams per metric ton gold	Pursued permits. Prefeasibility study completed in 1999.
Do.	Kabatas	Copper, gold	Anatolia Minerals Development Ltd. and Rio Tinto Mining & Exploration Ltd.	NA	Drilling, sampling, and trenching programs planned.
Do.	Karacam	Nickel	do.	NA	Drilling program planned.
Do.	Kaymaz	Gold	Tuprag Metal Madencilik San. Ve Tic. Ltd. Sti.	1.1 million metric tons grading 6.25 grams per metric ton gold	Awaited outcome of third party lawsuit concerning permits issued by the Ministry of Environment. Studied ore processing options. Prefeasibility study completed in 1997.
Do.	Kemaliya	Copper, gold	Anatolia Minerals Development Ltd. and Tuprag Metal Madencilik San. Ve Tic. Ltd. Sti.	NA	Drilling program planned.
Do.	Kisladag	Gold	Tuprag Metal Madencilik San. Ve Tic. Ltd. Sti.	126 million metric tons grading 1.2 grams per metric ton gold	Extensive drilling, production process scoping study, and metallurgical testwork completed in 2000. Plan prefeasibility study and environmental impact assessment.
Do.	Lucky Star	Zinc, lead, silver	Odyssey Resources Ltd.	NA	Stream sediment sampling and 2-hole preliminary diamond drilling program completed. Geophysical survey planned.
Do.	Uckapili	Gold	Anatolia Minerals Development Ltd. and Rio Tinto Mining & Exploration Ltd.	NA	Drilling program planned.
Do.	Yahyali	Zinc, lead, silver	Anatolia Minerals Development Ltd. and Cominco Madencilik Sanayi A.S.	NA	Exploration proposed.
Yemen	Al Hariqah	Gold	Canada Mountain Minerals (Yemen) Ltd.	NA	Completed drilling program. Plan to analyze soil and stream samples.
Do.	Al Jabali	Zinc, lead, silver	Anglo American plc, Ansan Wikfs Hadramaut Ltd., and ZincOx Resources plc	9.4 million metric tons grading 10.8% zinc, 2.3% lead, and 76.8 grams per metric ton gold	Completed preliminary reverse circulation and diamond drilling.
Do.	Suwar	Copper, nickel, cobalt	Canada Mountain Minerals (Yemen) Ltd. and Falconbridge International (Investments) Ltd.	NA	Completed a 15-hole 3,095 meter drilling program in 2000.

NA Not available.

1/ Resources reported where available based on data from various public sources. Data was not verified by the U.S. Geological Survey. Resources may include measured, indicated, and inferred resources.

THE MINERAL INDUSTRIES OF

BAHRAIN, KUWAIT, OMAN, QATAR, THE UNITED ARAB EMIRATES, AND YEMEN

By Philip M. Mobbs

BAHRAIN

In 2000, strong international demand lead to significantly higher than expected international petroleum prices, which benefited Bahrain's oil-based economy. Bahraini exports of crude oil and refined petroleum products, which were valued at \$4.0 billion[1] in 2000, accounted for 70% of Bahrain's total export earnings of \$5.7 billion compared with 1999 when exports of crude oil and petroleum products were valued at \$2.5 billion and accounted for 62% of total export earnings. In 2000, other mineral exports were valued at \$211 million (Bahrain Monetary Agency, 2001). The nation's gross domestic product (GDP) was estimated to have increased by 5% in 2000 compared with 1999 because of the surge in oil prices (Evertt-Heath, 2001a).

Aluminium Bahrain B.S.C. (ALBA) completed a facilities upgrade at its marine terminal. The new facilities included two 50,000-metric-ton alumina silos and a jetty capable of handling ships of up to 60,000 deadweight tons (dwt). The old terminal facilities were limited to ships of 30,000 dwt or less. The construction of a 450,000-metric-ton-per-year (t/yr) coke-calcining plant continued. ALBA planned to use imported green coke to produce anode-grade calcined coke, which, in turn, would be used to produce anodes for the aluminum smelter (Aluminium Bahrain B.S.C., 2001, A review of 2000, accessed July 7, 2001, at URL http://www.aluminiumbahrain.com/review/projects.htm). The feasibility of adding a fifth potline and expanding ALBA's nominal capacity to 750,000 t/yr from 500,000 t/yr was under active Government consideration (Mining Journal, 2000). Also in 2000, Gulf Aluminium Rolling Mill Co. B.S.C. began the installation of a 6,000-t/yr foil mill at its 120,000-t/yr-capacity aluminum rolling mill (Gulf Aluminium Rolling Mill Co. B.S.C., 2000, History, accessed July 6, 2001, at URL http://www.garmco.com/page3.htm).

Gulf Industrial Investment Co. pelleted imported iron ore. Pellets from its 4-million-metric-ton-per-year (Mt/yr) plant at Al-Hidd were exported for use in direct-reduction plants.

Cement was produced from imported clinker and raw materials at the Hundai Cement Factory. The plant's three clinker grinders had a rated capacity of 438,000 t/yr.

The Government's Bahrain Petroleum Company, B.S.C. (BAPCO) (closed) continued the upgrade of its 248,900-barrel-per-day (bbl/d)-capacity refinery at Sitra (U.S. Energy Information Administration, July 2000, Bahrain—Oil, accessed June 7, 2001, at URL http://www.eia.doe.gov/emeu/cabs/bahrain.html). Production of crude oil from the Awali Field, which was Bahrain's sole oilfield, reportedly increased slightly to nearly 38,000 bbl/d (Rashid H. Al-Dhubaid, Ministry of Oil and Industry, written commun., June 10, 2001). The BAPCO refinery supplemented throughput of Bahraini crude oil with imports, which included more than 140,000 bbl/d from the offshore Abu Saafa Field in Saudi Arabian waters (Everett-Heath, 2001a).

Bahrain has been producing crude oil from the Awali Field since 1932. Compagnie Générale de Géophysique of France was contracted to study the remaining production potential of the field. Additional petroleum exploration by Chevron Corp. and Texaco Inc. of the United States was underway.

Bahrain National Gas Co. B.S.C. (Banagas) had an input capacity of 8 million cubic meters per day at its liquefied petroleum gas (LPG) plant. Banagas' two gas-processing trains near Awali and Jabal al-Dukhan recovered propane, butane, and naptha from natural gas produced from the Abu Saafa and the Awali Fields. The resultant dry gas was used as an industrial fuel by ALBA, Banagas, and BAPCO (Bahrain National Gas Co. B.S.C., [undated], Our process, accessed July 6, 2001, at URL http://www.banagas.com.bh/b_processmain.html).

More-extensive coverage of the mineral industry of Bahrain is in the 1998 Minerals Yearbook, volume III, Mineral Industries of Africa and the Middle East.

KUWAIT

Kuwait's economy revolved around the production and refining of crude oil. In 2000, the petroleum and natural gas sector contributed about 48% of the GDP and 93% of Government revenue. The GDP was estimated to have increased to \$37.4 billion[2] at current prices in 2000, compared with \$29.3 billion in 1999 (Central Bank of Kuwait, 2001, Table A). Kuwait was the world's 13th leading oil producer (U.S. Energy Information Administration, 2001).

In 2000, total exports were valued at \$19.4 billion, of which oil exports accounted for \$18 billion and manufactured fertilizer exports accounted for \$65 million. In 1999, total exports were valued at \$12 billion, of which oil exports accounted for \$10.8 billion. Total imports in 2000 were estimated to be \$6.8 billion (Central Bank of Kuwait, 2001, Table A, Table 40).

Construction continued on Kuwait Cement Co.'s 1.8-Mt/yr grey clinker kiln. The kiln will burn imported limestone, and the output will be processed in Kuwait Cement's existing clinker grinding mills. Cement clinker imports were expected to end once production is established (Bell and others, 2001).

Petrochemical Industries Co. (PIC) proposed to upgrade the urea plant at Shuaiba to 1,750 metric tons per day (t/d) from 1,100 t/d and the ammonia plant to 880 t/d from 800 t/d. PIC also planned to construct a 2,000-t/d methanol plant (Middle East Economic Digest, 2001h).

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[1] Where necessary, values have been converted from Bahraini dinars (BhD) to U.S. dollars at the rate of BhD0.377=US\$1.00.

[2] Where necessary, values have been converted from Kuwaiti dinars (KD) to U.S. dollars at the average exchange rate of KD0.307=US\$1.00.

As international demand for petroleum increased in 2000, Kuwait increased crude oil production. Additional production capacity was being installed as crude oil Gathering Center 25 came on-line in March. China Petroleum Engineering & Construction Corp. was building the 190,000-bbl/d-crude-oil-capacity Gathering Center 27 at Umm Gudair and the 200,000-bbl/d-crude-oil-capacity Gathering Center 28 at the Minagish Field (Middle East Economic Digest, 2001c). Proven crude oil reserves at the beginning of the year were estimated by the U.S. Energy Information Administration to be 96.5 billion barrels (Gbbl) (including 2.5 Gbbl in the Neutral Zone). Natural gas reserves were estimated to be 1.5 trillion cubic meters (U.S. Energy Information Administration, August 2000, Kuwait—Energy overview, accessed May 11, 2001, at URL http://www.eia.doe.gov/emeu/cabs/kuwait.html).

The proposed redevelopment of the Abdali, the Bahrah, the Ratga, the Raudhatain, and the Sabriyah Fields by international oil companies known as "Project Kuwait" remained stalled in 2000. Petroleum product output also flagged after the June 25 explosion at the Mina al-Ahmadi refinery.

More-extensive coverage of the mineral industry of Bahrain is in the 1998 Minerals Yearbook, volume III, Mineral Industries of Africa and the Middle East.

OMAN

Petroleum and natural gas dominated Oman's economy. In response to increased international oil prices, the Omani GDP rose to $19.7 billion[3] at current prices in 2000 compared with $15.6 billion in 1999. Hydrocarbon activity, which was valued at $9.7 billion in 2000 and $6.8 billion in 1999, accounted for 49% of GDP in 2000 (Arif Ali, Gulf News, May 13, 2001, Oman's GDP jumps 26.7pc as industrial activity surges, accessed May 14, 2001, at URL http://www.gulf-news.com/Articles/news.asp?ArticleID=16984). In 2000, crude oil exports were valued at an estimated $9.2 billion of total exports of $11.1 billion (Middle East Economic Digest, 2001a).

The first evidence of copper production dated at Wadi Jizzi indicated that Oman has been a mineral producer for more than 5,000 years (M.J. Mizra, January 15, 2001, Status of mining activities in the Sultanate of Oman, accessed June 13, 2001, at URL http://www.geoconfoman.unibe.ch/contredetail.epl?id=315). In 2000, oil and gas output was supplemented by the production of chromite, gold, gypsum, sand and gravel, silver, and dimension stone; the smelting and refining of copper; and the manufacturing of cement.

Gold was mined from the Rakah deposit near Yanqui. The plant at Rakah processed about 100,000 t/yr of ore. The recovered gold doré and copper-refinery slimes that contained gold and silver were exported to be refined. Oman Mining Co. LLC fed its copper smelter and refinery operation at Sohar with imported copper concentrates. In 2000, National Mining Co. of Oman explored for copper, gold, and silver near Sohar. The Metal Mining Agency of Japan wrapped up its exploration for copper and gold in the South Batinaha area.

Construction of an industrial port at Sohar to service the mineral industry continued during 2000. A number of mineral-processing projects were under consideration; these included an aluminum smelter at Sohar, the construction of a 2,000-t/d ammonia plant and a 3,500-t/d urea plant at Sohar for Bahwan Trading Group, a ferrochrome project, a 5,000-t/d methanol plant at Sohar for Oman Oil Co., Oman Refining Co.'s 75,000-bbl/d oil refinery at Sohar, the expansion of the Sharq Sohar Steel Rolling Mills to 216,000 t/yr from 180,000 t/yr, and a 115-t/d Claus unit to recover sulfur. Also proposed was a 248,000-t/yr ammonia plant and a 1.6-Mt/yr granulated urea plant at Sur. Indian Farmers Fertiliser Co-operative Ltd. of India joined Oman Oil Co. in the Sur ammonia/urea project. Rashtriya Chemicals and Fertilisers Ltd. of India had withdrawn from the venture in 1999 (Bulk Materials International, 2000a, b; Middle East Economic Digest, 2001e, i, j; Metal Bulletin, 2000c; Stell, 2000; Alexander's Gas & Oil Connections, July 7, 2000, Oman invites tenders for new refinery, accessed August 7, 2000, at URL http://gasandoil.com/goc/news/ntm02744.htm; Arif Ali, November 19, 2000, Oman plans heavy industrial investment in diversification bid, accessed May 14, 2001, at URL http://www.gulf-news.com/articles/news.asp?ArticleID=2969).

Oman LNG LLC brought its two-train 6.6-Mt/yr-production-capacity liquefied natural gas (LNG) plant at Qalhat, about 200 kilometers (km) southeast of Muscat, on-line and began exporting LNG in 2000 (Oil & Gas Journal, 2000b). Oman LNG used about 70% of natural gas recovered in Oman. The Government was attempting to reduce flaring of natural gas, and in 2000, the Government formed Oman Gas Co. to supervise natural gas projects. A number of gas pipeline projects, which included a 305-km pipeline connecting the Fahud Field to Sohar, a 700-km line that would link the Saih Nihadya Field to Salalah (Port Raysut), and the linkage of Oman's natural gas pipeline network with that of the United Arab Emirates, were planned (Metal Bulletin, 2000b; Gulf News, November 16, 2000, Oman looks to use gas, train manpower to diversify, accessed May 14, 2001, at URL http://www.gulf-news.com/Articles/news?asp?ArticleID=2774).

The output of Petroleum Development Oman LLC accounted for about 94% of the crude oil produced in Oman; the remainder was produced by international oil companies. The Al-Noor, the Burhan, and the Mukhaizna fields began commercial production in 2000. At yearend, the country's proven oil reserves were estimated to be 5.5 Gbbl and natural gas reserves were estimated to be 829.7 billion cubic meters (U.S. Energy Information Administration, 2001, Oman—Energy overview, accessed July 9, 2001, at URL http://www.eia.doe.gov/emeu/cabs/oman2.html).

More-extensive coverage of the mineral industry of Bahrain is in the 1998 Minerals Yearbook, volume III, Mineral Industries of Africa and the Middle East.

QATAR

Much of the Qatari economy was based on the production of natural gas, petrochemicals, crude oil, and refined petroleum products. In response to the continued oil price rebound, the Qatari GDP was estimated to have reached $14.6 billion[4] compared with $12.2 billion in 1999. Oil and natural gas accounted for $7.3 billion (50% of the GDP) in 2000 compared with $5.5 billion (45% of GDP) in 1999. Petroleum and natural gas accounted for about 80% of Government revenues (Everett-Heath and Hindley, 2001).

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[3] Where necessary, values have been converted from Omani rials (OR) to U.S. dollars at the average exchange rate of OR0.385=US$1.00.

[4] Where necessary, values have been converted from Qatari rials (QR) to U.S. dollars at the average exchange rate of QR3.64=US$1.00 for 2000.

A number of oil and gas projects, which included pipeline projects to export natural gas from the North Field to Kuwait, Oman, and the United Arab Emirates, were under consideration in 2000. Qatar Liquefied Gas Co. proposed to add 3.2-Mt/yr LNG capacity to its current 6-Mt/yr capacity, and Ras Laffan Liquefied Natural Gas Co. was pursing an 8.8-Mt/yr LNG-capacity expansion (Middle East Economic Digest, 2001d). In 2000, LNG production was estimated to be 10.4 million metric tons (Mt) compared with an estimated 6.4 Mt in 1999 (Everett-Heath and Hindley, 2001).

During 2000, Qatar General Petroleum Corp. (QGPC) absorbed National Oil Distribution Co., which operated the Mesaieed petroleum refinery. QGPC (51% interest) and Sasol Synfuels International Ltd. (49% interest) continued negotiations on a 34,000-bbl/d gas-to-liquids (GTL) plant proposed to be built in Ras Laffan. Although Phillips Petroleum Co. withdrew from the GTL venture in May 2000, the company continued as project manager for QGPC's fourth natural gas liquids (NGL) plant at Mesaieed, which was expected to be on-line in 2002 (Sasol Ltd., 2000). The NGL plants processed natural gas to extract condensate and LPG. In 2000, QGPC continued an economic evaluation of the construction of a fifth NGL plant. Qatar Fertiliser Co. proposed a $500 million expansion of its fertilizer complex, also in Mesaieed, which would increase ammonia production capacity by about 660,000 t/yr and urea output by about 1 Mt/yr (Evans, 2001).

At the beginning of the year, Qatar's proven oil reserves were estimated to be 3.7 Gbbl, and natural gas reserves were estimated to be 8.5 trillion cubic meters (U.S. Energy Information Administration, 2000, Qatar—Energy overview, accessed May 11, 2001, at URL http://www.eia.doe.gov/emeu/cabs/qatar.html).

More-extensive coverage of the mineral industry of Bahrain is in the 1998 Minerals Yearbook, volume III, Mineral Industries of Africa and the Middle East.

UNITED ARAB EMIRATES

Abu Dhabi, which dominated the hydrocarbon industry of the United Arab Emirates[5] (UAE), accounted for most of the country's crude oil and natural gas production (Arab Petroleum Research Center, 2000, p. 471-474). Other minerals and mineral commodities produced in the UAE included aluminum and steel from Dubai; ammonia from Abu Dhabi; cement manufactured in Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al-Khaimah, and Sharjah; and chromite mined in Fujairah. All mineral resources were controlled by the individual emirates and loosely administered by the Federal Government.

The increase in the average price of a barrel of oil sold by the UAE to $26.10 in 2000 from $17.60 in 1999 and $12.40 in 1998 was reflected in the surge of the country's GDP. According to data from the Central Bank, GDP was $60.9 billion[6] in 2000 compared with $51.9 billion in 1999 and $47.2 billion in 1998. Crude oil accounted for 34% of the GDP in 2000 compared with 26% in 1999. Other mining and quarrying accounted for about 0.03% of the GDP. In 2000, total exports were valued at $43.3 billion, of which crude oil exports accounted for $19.1 billion and natural gas exports accounted for $2.5 billion. In 1999, total exports were valued at $35.1 billion, of which crude oil exports accounted for $12.4 billion and natural gas exports accounted for $2.0 billion (Everett-Heath, 2001b, c).

The Sharjah Petroleum Council was created to replace Sharjah's Department of Oil and Minerals in October 1999. In 2000, the Department of Oil was created to supervise the oil and gas sector in Ajman.

In 1999, Dubai Aluminium Co. (Dubal) added 240 new reduction cells in two potlines, and the total plant capacity was increased to 536,000 t/yr. This expansion, which was code named "Condor," increased production capacity by 146,000 t/yr. In 2000, the feasibility study was completed for Dubal's proposed "Heron" 400,000-t/yr expansion project (Metal Bulletin, 2000a).

In 1998, financial problems exacerbated by low international oil prices forced Metro Oil Corp. to suspend operations at its 75,000-bbl/d oil refinery in Fujairah. In 2000, Metro established the Fujairah Refinery Co. to restart the refinery. Metro also was evaluating the expansion of the refinery's capacity to 90,000 bbl/d (Oil & Gas Journal, 2000a). In 1999, ENOC Processing Co. Ltd. started production at its $300 million 120,000-bbl/d-capacity condensate refinery at Jebel Ali in Dubai (Oil & Gas Journal, 2000c). ENOC was a subsidiary of Emirates National Oil Co.

Abu Dhabi Oil Refining Co. (Takreer), which was a subsidiary of Abu Dhabi National Oil Co., expanded its Ruwais refinery to a throughput capacity of 415,000 bbl/d with the addition of two 140,000-bbl/d condensate-processing trains (Iran Daily, July 6, 2001, Oil & gas—UAE refinery almost complete, accessed July 10, 2000, at URL http://www.iran-daily.com/3). Takreer deferred the construction of an 135,000-bbl/d distillation capacity project at Ruwais. In addition to the Ruwais refinery, Takreer also operated a 85,000 bbl/d oil refinery at Umm al-Nar (Arab Petroleum Research Center, 2000, p. 487).

At the beginning of 2000, the country's proven oil reserves were estimated to be 97.8 Gbbl, and natural gas reserves were estimated to be 6 trillion cubic meters (U.S. Energy Information Administration, 2000, United Arab Emirates—Energy overview, accessed May 11, 2001, at URL http://www.eia.doe.gov/emeu/cabs/uae2.html).

More-extensive coverage of the mineral industry of Bahrain is in the 1998 Minerals Yearbook, volume III, Mineral Industries of Africa and the Middle East.

YEMEN

Crude oil production formed a preeminent segment of the Yemeni economy. Oil and gas production accounted for an estimated 25% of the $6.7 billion[7] GDP in 1999 (the last year for which data are available). Crude oil refining accounted for about 3% of the GDP. Mining and quarrying, which included the production of gypsum, salt, and stone, was valued at $17 million and accounted for 0.3% of the GDP in 1999 (Enders and others, 2001, p. 146).

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[5] Comprises the following: Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al-Khaimah, Sharjah, and Umm al-Qaywayn.

[6] Where necessary, values have been converted from United Arab Emirate Dirham (AED) to U.S. dollars at the rate of AED3.67=US$1.00 for 1999 and 2000.

[7] Where necessary, values have been converted from Yemeni rials (YR) to U.S. dollars at the exchange rate of YR159.7 for 1999.

Most of Yemen's crude oil production was exported. Preliminary data for 1999 indicated crude oil exports were valued at $2.1 billion and refined oil products exports were valued at $194 million; thus oil accounted for more than 90% of total exports of $2.5 billion.

ZincOx Resources plc of the United Kingdom continued the evaluation of Al-Jabail zinc deposit. Anglo American Corp. had explored the region in the late 1990s.

State-owned General Corp. for Cement Production and Marketing operated cement plants at Amran, Bajil, and Taiz with a total clinker production capacity of 1.25 Mt/yr (Middle East Economic Digest, 2001b). The corporation was up for privatization.

With the strong international demand in 2000, Yemen set a new national record for crude oil production, and several new oil discoveries were announced (Middle East Economic Digest, 2001f). The successful completion of a border treaty with Saudi Arabia opened additional prospective territory for petroleum exploration. According to the Government, recoverable crude oil reserves were 2.8 Gbbl, and proven natural gas reserves were 142 billion cubic meters (Enders and others, 2001, p. 16, 22; Middle East Economic Digest, 2001g).

In 2000, the Al-Kuthairi Group of Yemen planned to build a 60,000-bbl/d oil refinery in the Hadhramaut, and the Yemen Liquefied Natural Gas Co. evaluated the construction of a 6.2-Mt/yr two-train natural gas liquefaction plant (Middle East Economic Digest, 2001g). The Government's Aden Refinery Co. operated an aging oil refinery in Aden with an effective throughput capacity estimated to be about 70,000 bbl/d. Privatization of the Aden refinery was underway. The 10,000 bbl/d-capacity Marib refinery was operated by Yemen Hunt Oil Co. (Enders and others, 2001, p. 17).

More-extensive coverage of the mineral industry of Bahrain is in the 1998 Minerals Yearbook, volume III, Mineral Industries of Africa and the Middle East.

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TABLE 1
BAHRAIN, KUWAIT, OMAN, QATAR, THE UNITED ARAB EMIRATES, AND YEMEN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1996	1997	1998 e/	1999 e/	2000 e/
BAHRAIN 3/					
Aluminum, smelter output, primary metal	461,245	489,847	501,308 r/ 4/	502,663 r/ 4/	509,038 4/
Cement	192,000	171,854	230,422	156,100 r/ 4/	88,806 4/
Gas, natural:					
Gross million cubic meters	10,210	10,625	11,120	11,470 4/	11,500
Dry do.	8,030 r/	8,000 r/	8,500 r/	8,789 r/ 4/	8,966 4/
Methanol	384,558	447,969	384,111 r/ 4/	421,946 r/ 4/	370,000 4/
Natural gas plant liquids:					
Propane thousand 42-gallon barrels	1,272	1,213	1,192 r/ 4/	1,144 r/ 4/	1,055 4/
Butane do.	1,087	1,048	1,024 r/ 4/	1,005 r/ 4/	955 4/
Naphtha do.	1,784	1,716	1,661 r/ 4/	1,683 r/ 4/	1,626 4/
Nitropen, N content of ammonia	322,500	355,900	335,900 4/	369,500 r/ 4/	349,900 4/
Petroleum:					
Crude thousand 42-gallon barrels	14,124	14,159	13,750	13,670 4/	13,766 4/
Refinery products: e/					
Liquefied petroleum gas do.	300 e/	300 e/	300 e/	335 4/	346 4/
Gasoline do.	8,139 r/ 4/	7,377 4/	6,344 r/ 4/	6,756 r/ 4/	7,090 4/
Jet fuel do.	6,200 4/	6,500	9,125 r/ 4/	9,520 r/	9,450
Kerosene do.	11,300 4/	17,501 4/	8,030 r/ 4/	9,000 r/	9,000
Distillate fuel oil do.	31,050 4/	32,074 r/ 4/	31,591 r/ 4/	30,000 r/	29,000
Residual fuel oil do.	20,800 4/	20,800 e/	19,719 r/ 4/	22,066 r/ 4/	21,278 4/
Other do.	14,430 r/	19,700 e/ r/	19,700 r/	16,700 r/	16,500
Total do.	92,219 4/	104,000 r/	94,800 r/	94,400 r/	92,700
Sulfur	74,282	66,334	66,500	66,500	66,400
KUWAIT 5/					
Cement e/	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Lime, hydrated and quicklime e/	40,000 r/	40,000 r/	40,000 r/	40,000 r/	40,000
Natural gas: 6/					
Gross million cubic meters	10,890	10,870	11,100	10,144 r/	11,000
Dry do.	9,300	9,250	9,500	8,688 r/	9,500
Natural gas liquids e/ thousand 42-gallon barrels	35,000	37,000	37,000	38,000	38,000
Nitrogen:					
N content of ammonia	411,900	432,000	452,300 4/	396,800 4/	409,500 4/
N content of urea	356,300	348,500	361,300 4/	330,900 4/	287,600 4/
Petroleum:					
Crude 6/ thousand 42-gallon barrels	743,047	760,295	761,025 4/	708,000	800,000
Refinery products:					
Gasoline, motor do.	13,874	15,475	17,520 r/ 4/	17,000	10,000
Kerosene do.	44,202	49,303	51,470 r/ 4/	50,000	35,000
Distillate fuel oil do.	86,742	96,754	91,980 r/ 4/	92,000	70,000
Residual fuel oil do.	73,770	82,270	75,550 r/ 4/	72,000	55,000
Other do.	52,067	58,882	86,870 r/ 4/	80,000	60,000
Total do.	270,655	302,684	323,390 r/	311,000	230,000
Salt	100,000 e/	100,000 e/	100,000	100,000	100,000
Sulfur:					
Elemental, petroleum byproduct	595,000	675,250 r/	665,000	675,000	600,000
Sulfuric acid e/	10,000	10,000	10,000	10,000	10,000
OMAN					
Cement, hydraulic	1,260,000	1,264,000	1,300,000	1,300,000	1,716,000
Chromite, gross weight	15,252	18,000	28,684 4/	26,004 r/ 4/	15,110 4/
Copper, metal					
Smelter	24,663	22,800	24,400 4/	16,818 r/ 4/	23,790 4/
Refinery	24,150	23,600	22,700	17,171 r/ 4/	24,281 4/

See footnotes at end of table.

TABLE 1--Continued
BAHRAIN, KUWAIT, OMAN, QATAR, THE UNITED ARAB EMIRATES, AND YEMEN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998 e/	1999 e/	2000 e/
OMAN--Continued						
Gas, natural:						
Gross	million cubic meters	9,071	8,200	8,800 4/	8,500	8,500
Dry	do.	6,716	7,750	7,800	8,000 r/	8,000
Gold	kilograms	576	577	575	597 r/ 4/	604 4/
Gypsum		130,900	113,600	115,000	180,129 r/ 4/	131,909 4/
Natural gas liquids e/	thousand 42-gallon barrels	3,650	3,800	4,000	6,000	6,000
Petroleum:						
Crude	do.	322,300	329,960	328,500 4/	328,100 4/	330,000
Refinery products:						
Liquefied petroleum gas	do.	250	310	350 r/	365	350
Gasoline	do.	4,888	4,000	5,100 r/	4,500	5,000
Jet fuel	do.	2,500	1,100	1,100 r/	1,200	1,200
Kerosene	do.	90	90	100 r/	90	100
Distillate fuel oil	do.	4,800	4,745	6,200 r/	5,000	5,500
Residual fuel oil	do.	12,500	12,775	14,200 r/	13,000	14,000
Other e/	do.	500	1,500	700	700	700
Total e/	do.	25,500	24,500	27,800 r/	24,900	26,900
Sand and gravel		9,629,000	9,800,000	9,800,000	15,681,951 r/ 4/	22,448,254 4/
Silver	kilograms	97	95 e/	95	236 r/ 4/	306 4/
Stone:						
Marble		117,000	169,000	170,000	188,545 r/ 4/	147,686 4/
Other		2,263,000	1,992,000	2,000,000	3,813,821 r/ 4/	3,537,216 4/
Sulfur e/		30,000	30,000	30,000	30,000	30,000
QATAR 7/						
Cement, hydraulic		690,000	692,000	700,000	1,025,000 r/	1,050,000
Gas, natural:						
Gross	million cubic meters	18,950	24,210	26,200 r/	32,000 r/	35,000
Dry	do.	13,700	17,270	19,540 4/	24,000 r/	26,000
Iron and steel, metal:						
Direct-reduced iron		632,000	570,000	706,000 4/	670,000	620,000
Steel, crude		626,000	616,000	646,000 4/	629,000	729,000 4/
Semimanufactures:						
Billet		617,000	608,000	637,000 4/	640,000	640,000
Bars		601,000	596,000	597,000 4/	600,000	6,000,000
Natural gas liquids	thousand 42-gallon barrels	21,000 e/	22,000	22,000	22,000	22,000
Nitrogen:						
N content of ammonia		635,027	942,500	1,127,300 r/ 4/	1,129,600 r/ 4/	1,097,000 4/
N content of urea		715,000	670,000	767,000 4/	757,000 4/	748,100
Petroleum:						
Crude	thousand 42-gallon barrels	186,150	236,885	254,040 4/	232,000	254,000
Refinery products:						
Gasoline	do.	3,942	4,380	5,100 r/	5,400 r/	5,500
Kerosene	do.	3,321	3,285	3,300 r/	3,900 r/	4,000
Distillate fuel oil	do.	6,997	5,110	5,100 r/	4,900 r/	5,100
Residual fuel oil	do.	6,860	6,205	6,900	6,750 r/	6,900
Other	do.	1,100	5,840	2,200 r/	1,600 r/	2,000
Total	do.	22,220	24,820	22,600 r/	22,500 r/	23,500
Stone, limestone e/		900,000	900,000	900,000	900,000	900,000
Sulfur e/		45,000	73,000	146,000	155,000	150,000
UNITED ARAB EMIRATES 8/						
Aluminum, primary		258,500	381,000	352,000	440,000	470,000
Cement, hydraulic e/		6,000,000	5,200,000	6,000,000	6,100,000 r/	6,100,000
Chromite, gross weight		56,000	61,000	76,886 4/	60,000	60,000
Fertilizer materials, nitrogen:						
N content of ammonia		331,200	372,500	331,000 4/	380,200 4/	348,400 4/
N content of urea		258,400	303,520	259,000	271,500 4/	243,400 4/
Gas, natural:						
Gross	million cubic meters	46,530	48,500	48,980 r/ 4/	50,200 r/ 4/	52,000
Dry	do.	33,800 r/	36,310 r/	37,070 r/	38,500 r/	39,000
Gypsum e/		90,000	90,000	90,000	90,000	90,000
Lime e/		50,000	50,000	50,000	50,000	50,000
Natural gas liquids e/	thousand 42-gallon barrels	110,000	110,000	110,000	110,000	110,000

See footnotes at end of table.

TABLE 1--Continued

BAHRAIN, KUWAIT, OMAN, QATAR, THE UNITED ARAB EMIRATES, AND YEMEN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998 e/	1999 e/	2000 e/
UNITED ARAB EMIRATES--Continued						
Petroleum:						
Crude	thousand 42-gallon barrels	831,470	845,340	880,000	756,000	900,000
Refinery products:						
Gasoline	do.	12,446	12,812	13,100 r/	12,800	13,000
Kerosene	do.	20,330	24,419	21,200 r/	21,000 r/	21,000
Distillate fuels	do.	24,090	27,521	24,500 r/	24,400 r/	25,000
Residual fuels	do.	16,717	17,812	13,500 r/	12,300 r/	12,500
Other	do.	12,154	26,061	19,700 r/	10,700 r/	11,000
Total	do.	85,737	108,625	92,000 r/	81,200	83,000
Steel e/		70,000	70,000	70,000	70,000	70,000
Sulfur, byproduct of petroleum refining and natural gas processing e/		780,000 4/	967,000 4/	967,000 4/	1,089,000 4/	1,120,000 4/
YEMEN						
Cement		1,028,000	1,235,000	1,201,404 r/ 4/	1,453,787 r/ 4/	1,400,000
Gypsum		97,000	101,000	102,000 4/	103,000 r/ 4/	100,000
Marble	thousand square meters	82	84	86 4/	88 r/ 4/	86
Natural gas: e/						
Gross 9/	million cubic meters	14,000 r/	13,500 r/	15,000 r/	16,000 r/	18,000
Liquids	thousand 42-gallon barrels	1,900 r/	1,800 r/	2,000 r/	2,200 r/	2,400
Petroleum:						
Crude	do.	126,655	125,560	138,600 4/	149,000 r/	167,000
Refinery products:						
Gasoline	do.	8,913	8,803	9,100 4/	9,100	9,100
Kerosene	do.	4,935	4,073	3,700 4/	3,700	3,700
Distillate fuel oil	do.	10,525	10,530	6,900 4/	6,900	6,900
Residual fuel oil e/	do.	10,300	10,300	10,600	10,600	10,600
Other e/	do.	2,000	2,000	3,700 4/	3,700	3,700
Total	do.	36,673	35,706	34,000 4/	34,000	34,000
Salt		135,000	136,000	147,000 4/	149,000 r/ 4/	150,000
Stone, dimension	thousand cubic meters	2,397	2,485	2,497 4/	2,547 r/ 4/	2,500

e/ Estimated. r/ Revised.

1/ Table includes data available through June 8, 2001.

2/ Estimated data are rounded to no more than three significant digits and may not add to totals shown.

3/ In addition, iron ore was pelleted and exported for use by direct reduction plants. Pellets were produced from imported iron ore. Production was, in million metric tons: 1996--2.9; 1997--3.23; 1998--1.9; 1999--2.7; and 2000--3.7. Since 1998, granular urea has been produced from locally produced ammonia.

4/ Reported figure.

5/ In addition to commodities listed, caustic soda, chlorine, clays, clay products, and sand and gravel are produced, but available information is inadequate to make estimates of output.

6/ Includes Kuwait's share of production from the Partitioned Zone.

7/ In addition to commodities listed, clays, gypsum, and sand and gravel for construction purposes and methanol are produced, but available information is inadequate to make estimates of output.

8/ In addition to the commodities listed, crude industrial minerals, such as common clays, diabase, gravel, limestone, marble, sand and shale, presumably are produced, but output is not reported, and information is inadequate to make estimates of output.

9/ Most produced associated natural gas was stripped of liquids and reinjected.

THE MINERAL INDUSTRY OF

CYPRUS

By Philip M. Mobbs

In 2000, the mineral industry of Cyprus[1] was dominated by the production of bentonite, cement, copper, and refined petroleum products. About 250 quarries produced aggregates, clay, gypsum, sand, and stone for local use and bentonite, gypsum, ocher, and umber for export. In 2000, copper exports were valued at about $9.2 million[2] of total domestic exports of $387 million. Fuel imports were about $435 million of Cyprus' $3.8 billion total imports. In 1999 (the last year for which national account data were available) Cyprus' gross domestic product was estimated to be $9.2 billion, and the population was 666,800. The Turkish Cypriot population was estimated to be about 88,000 (Statistical Service of Cyprus, October 26, 2000, Population, accessed May 27, 2001, at URL http://kypros.org/DSR/key_figures/population/ index.htm; Statistical Service of Cyprus, February 13, 2001, National accounts, accessed May 27, 2001, at URL http://kypros.org/DSR/key_figures/national/index.htm; Statistical Service of Cyprus, April 20, 2001, Foreign trade, accessed May 27, 2001, at URL http://kypros.org/DSR/key_figures/foreign_trade/index.htm).

In antiquity, Cyprus was famous for its copper production; in the Middle Ages, the island was noted for its salt exports (Luke and Jardine, 1920, p. 126, 220, 230). In the early 20th century, chrysotile asbestos was the major mineral export (Bear, 1963, p. 127-130). Commercial asbestos mining ceased in 1988, although some production reportedly continued until 1995 (King, 1992, p. 10-11; Fide, 1997, p. 211). Copper exports from Cyprus resumed in the 20th century when Cyprus Mines Corp. of the United States initiated copper production operations at Mavrovouni in 1919 and at Skouriotissa in 1922 (Luke and Jardine, 1920, p. 220-223; Fide, 1997, p. 211). Except for a hiatus during World War II, copper was produced by several companies from a number of mines until 1974 when armed confrontation between Greek and Turkish Cypriot military forces suspended mining operations. Cyprus Mines, which was the major copper miner, terminated operations when its facilities and mines were bisected by the cease-fire demarcation line between Greek and Turkish forces (Shekarchi, 1977, p. 277). Other companies resumed copper production until 1979, when low copper prices resulted in the suspension of the last copper mining operation (Morse and Stevens, 1981, p. 287; Shekarchi, 1982, p. 276). Hellenic Mining Co. of Cyprus recovered copper cement from leached mine wastes at Skouriotissa from 1981 until 1993. Copper mining resumed at Skouriotissa in 1996 (Michalski, 1998). Other notable mineral production on Cyprus included chromite (1924-1982), gold and silver (1934-1944), and gypsum, mineral pigments (ocher, terra verte, and umber), and stone (through the ages).

Government Policies and Programs

The Mines Service of the Ministry of Agriculture, Natural Resources, and Environment administered mineral operations under the Mines and Quarries (Regulation) Law, chapter 270, 1959; the Mines and Quarries Regulations, 1958-79; and the Cyprus Standard and Control of Quality Law, 1975. Royalties on extracted mineral commodities ranged from 1% to 5%. The Ministry's Geological Survey Department was responsible for mineral exploration programs and the evaluation of the country's resources. The Environmental Service was responsible for coordinating the environmental efforts of the Government departments.

In preparation for the nation's anticipated joining the European Union (EU), the Government raised the value-added tax (VAT) to 10% in July 2000. By January 2003, the VAT was scheduled to reach 15% (Noah Haglund, Cyprus Mail, July 1, 2000, VAT goes up today, accessed May 27, 2001, at URL http://www.cyprus-mail.com/July/1/news070101.htm). To conform with EU Directive 68/414/EEC, the Government needed to site, build, and fill tanks with an additional 1.5 million barrels of crude oil (Office of the Chief Cyprus—European Union Negotiator, [undated], Overview of alignment with the Acquis Communautaire, accessed May 29, 2001, at URL http://www.cyprus-eu.org.cy/eng/09_position_papers/chapter_14.htm).

To conform with EU regulations and standards, the Government proposed a $40 million program to upgrade the Cyprus Petroleum Refinery, Ltd., at Larnaca, which would increase the production of low-sulfur diesel fuel and unleaded gasoline (Anthony Miller, August 26, 2000, Larnaca protest plans in anger over refinery, accessed May 28, 2001, at URL http://www.cyprus-mail.com/August/26/news08606.htm). About 63% of gasoline sold in Cyprus was leaded (Menelaos Hadjicostis, April 20, 2001, Children in lead protest at ministry, accessed May 29, 2001, at URL http://www.cyprusweekly.com.cy/archives/20Apr2001.htm). National particulate emissions limits were reduced to 50 milligrams per cubic meter of discharged air effective January 1, 2001. Additionally, the Government anticipated limiting the Electricity Authority of Cyprus (EAC) to 66.6% of the electricity distribution market (Cyprus Mail, February 21, 2001, EAC to lose power monopoly by 2003, accessed May 28, 2001, at URL http://www.cyprus-mail.com/February/28/news11.htm).

Commodity Review

Copper and Gold.—Hellenic Copper Mines Ltd. [a consortium whose members included Hellenic Mining, Mytilineos Holdings S.A. of Greece, and Oxiana Europe Ltd. of the Channel Islands (a subsidiary of Oxiana Resources NL of Australia)] operated the Skouriotissa copper mine. Development of the Phoenix pit at Skouriotissa continued. In 2000, the company mined 963,092 metric tons (t) of high-grade copper ore (0.73% Cu) and 1.3 million metric tons of low-grade ore (0.33% Cu). Additional heap leach pads were added to the operation and the treatment plant was expanded. Copper cathode production increased to 5,197 t in 2000 compared with 5,004 t in 1999. Hellenic Copper Mines evaluated the Apliki, the Three Hills, and the West Apliki deposits and increased its estimate of low-grade resources in the Phoenix pit (Oxiana Resources NL, 2001, p. 8).

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[1] Unless specifically stated, all data in this chapter are for the Republic of Cyprus in southern Cyprus because data related to the Turkish-controlled areas of northern Cyprus are sparse or unavailable.

[2] Where necessary, values have been converted from Cypriot pounds to U.S. dollars at the rate of Cy£0.62=US$1.00.

In 2000, Eastern Mediterranean Minerals (Cyprus) Ltd. (EMM) [a joint venture of the Hellenic Mining (50%) and Oxiana Europe (50%)] continued exploration for volcanogenic massive sulfide base metals and gold deposits on the Troodos Ophiolite Complex with drilling on the Alestos and the Red Hills Prospects. EMM proposed to evaluate the Klirou prospect and the Shia-New Shia-Mathiatis trend in 2001.

Lead.—Tests of school children living near the Marios & Andreas Foundry in Ergates near Nicosia resulted in finding abnormally high levels of lead and cadmium in their blood (Anthony Miller, Cyprus Mail, November 11, 2000, UK experts deliver damning report on foundry pollution, accessed May 28, 2001, at URL http://www.cyprus-mail.com/November/11/index.htm). The foundry was temporarily closed. Complaints lodged by the residents of Omonia about smells and smoke from the Nemitsas Foundry near Limassol resulted in the Government agreeing to similar testing of the residents of Omonia and Zakaki and the area around the foundry for heavy-metal contaminants. In 2000, Nemitsas completed a $160,000 upgrade of its smokestack bag-house and filter system to conform with the 2001 particulate matter emissions standards.

Natural Gas and Petroleum.—In December, the Government began discussions with Egypt concerning the possibility of Egyptian natural gas reservoirs extending into the 200-nautical-mile Cypriot exclusive economic zone and the extension of the proposed Egypt-Lebanon natural gas export pipeline to Cyprus (Phillippos Stylianou, Cyprus Weekly, January 26, 2001, Local news—Cyprus braces for oil bonanza, accessed May 29, 2001, at URL http://www.cyprusweekly.com.cy/archives/26Jan2001.htm).

High crude oil prices resulted in the Government introducing an automatic price adjustment formula to replace the former system of the House of Representatives setting retail fuel prices. The Ministry of Commerce, Industry, and Tourism proposed to move the 28,500-barrel-per-day-capacity oil refinery at Larnaca to the former Vassiliko Chemical Industries site, about 15 kilometers east of Limassol (Athena Karsera, Cyprus Mail, December 8, 2000, Refinery deal could free Larnaca seafront by 2013, accessed May 28, 2001, at URL http://www.cyprus-mail.com/December/8/news9.htm).

Salt.—Commercial salt production was not expected to resume. Sections of the Larnaca salt lake had been converted into an unofficial long-term parking lot for the Larnaca International Airport (George Psyllides, August 24, 2000, Airport authorities ponder salt lake parking eyesore, accessed May 28, 2001 at URL http://www.cyprus-mail.com/August/news082404.htm).

Infrastructure

Mineral exports and imports transited through the ports of Larnaca, Limassol, and Vassiliko or the petroleum products terminals at Dhekelia, Larnaca, and Moni.

The EAC had an installed electricity generating capacity of 987.5 megawatts (MW). This included the 360-MW Dhekelia "B" generating station, which was powered by fuel oil; the 330-MW Moni powerplant, which burned diesel and fuel oils; and a 37.5-MW unit at Vassiliko. In December 2000, EAC added fuel-oil-fired units with an electricity generating capacity of 260-MW to the Vassiliko powerplant (Elias Hazou, Cyprus Mail, December 2, 2000, Greens protest new power station, accessed May 28, 2001, at URL http://www.cyprus-mail.com/December/2/news5.htm; Electricity Authority of Cyprus, [undated], Generation system, accessed May 11, 2001, at URL http://www.eac.com.cy/English_Version/ Generation_system_ENG.html).

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Major Sources of Information

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TABLE 1
CYPRUS: PRODUCTION OF MINERAL COMMODITIES 1/ 2/ 3/

(Thousand metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000
Cement, hydraulic		1,021 r/	910	1,207 r/	1,157 r/	1,398
Clays:						
Bentonite	metric tons	70,927	98,700 r/	121,850 r/	138,853 r/	126,313
Other: e/						
For brick and tile manufacture		400	350	380	350 r/ 4/	350
For cement manufacture		350	340	370	360 r/ 4/	400
Total		750	690	750	710	750
Copper, refined	metric tons	1,499	4,435	4,936 r/	5,004	5,197
Gypsum, crude 5/	do.	94,050 r/	234,300 r/	296,800 r/	181,546 r/	138,076
Lime, hydrated e/	do.	6,000	6,000	5,500	6,000 r/ 4/	6,800 4/
Petroleum refinery products:						
Liquefied petroleum gases	42-gallon barrels	306,159	367,047	344,068	392,776	345,286
Gasoline	do.	807,433	1,199,327	1,207,575	1,262,901	1,288,584
Kerosene and jet fuel	do.	157,298	195,368	211,817	237,744	285,090
Distillate fuel oil	do.	2,773,270	3,579,420	3,648,425	3,982,872	4,048,893
Residual fuel oil	do.	1,240,412	1,949,289	2,128,956	2,379,045	2,252,312
Bitumen	do.	166,226	207,046	208,355	205,622	207,082
Other	do.	22,359	2,092	20,116	21,796	16,032
Total	do.	5,473,157 r/	7,499,589 r/	7,769,312 r/	8,482,756 r/	8,443,279
Stone, sand, gravel:						
Marble		21 r/	25 r/	7 r/	2 r/	2
Marl, for cement production e/		1,600	1,500	1,900	1,600 r/ 4/	1,800 4/
Sand and gravel 6/		7,290 r/	6,990 r/	8,400 r/	9,150 r/	9,570
Building stone		77 r/	28 r/	40 r/	63 r/	92
Umber	metric tons	4,604	7,120 r/	6,056 r/	9,169 r/	12,258

e/ Estimated. r/ Revised.

1/ Table includes data available through May 31, 2001.

2/ Small quantities of the mineral pigments ocher and terra verte are mined intermittently. Mineral production data from the northern Turkish-occupied section of the country and production of secondary metals from scrap are not included in this table because available information is inadequate to make estimates of output.

3/ Sources: Statistical Service of Cyprus, Mines Service, company annual reports.

4/ Reported figure.

5/ About 4,000 metric tons per year of gypsum was calcined.

6/ Includes crushed aggregate and crushed limestone (Havara).

THE MINERAL INDUSTRY OF

IRAN

By Philip M. Mobbs

In 2000, Iran, which was the world's fourth largest producer of crude oil, averaged about 3.72 million barrels per day (Mbbl/d). Average crude production had been 3.56 Mbbl/d in 1999 and 3.63 Mbbl/d in 1998 (U.S. Energy Information Administration, 2001). At the end of 2000, Iran had the second largest natural gas reserves (23 trillion cubic meters) and the fifth largest crude oil reserves [89.7 billion barrels (Gbbl)] in the world according to the Oil & Gas Journal (2000b). These figures apparently do not include 1999 or 2000 Iranian reserve additions. Petroleum continued to provide the bulk of Iran's foreign exchange.

The gross domestic product of this Middle Eastern country of about 63 million people was estimated to be $110.8 billion in 1999 (the last year for which data were available) (World Bank Group, August 30, 2000, Iran, Islamic Rep. at a glance, accessed September 10, 2001, at URL http://www.worldbank.org/cgi-bin/sendoff.cgi?page=%2Fdata%2Fcountrydata%2Faag%2Firn_aag.pdf). Although inflation was high, according to the Iranian Central Bank, it dropped to about 13% in 2000 compared with 14.5% in 1998 and about 50% in 1995 (Middle East Economic Digest, 2001b).

Government Policies and Programs

During 2000, the Government merged the Ministry of Mines and Metals and the Ministry of Industry to form the Ministry of Industry and Mines. Parliament forwarded a draft investment law to the Council of Guardians for approval. When signed, the new law will replace the Law on Attraction and Protection of Foreign Investment (LAPFI) (Dinmore, 2000). Under LAPFI, direct foreign investment was restricted to joint ventures.

The loss of projected revenue during the oil price decline in 1997, 1998, and early 1999 focused the Government on the need for a more diversified economy. During the Third Five-Year Economic Development Plan for the Iranian years 1379 to 1384 (March 21, 2000, to March 20, 2005), the Government proposed to privatize 40 mineral industry companies affiliated with the Ministry of Industry and Mines and 23 companies associated with the Ministry of Petroleum. This continues the privatization program that has been ongoing for the past several years through which the Government has divested itself of numerous smaller mineral enterprises.

Since 1998, the Government has allowed foreign investment in solid mineral exploration joint ventures. Following the 1998 National Iranian Oil Co. (NIOC) proposal to contract out about 100 oil and gas projects to international companies, the Government invited foreign investment into the solid minerals sector in 1999 as it showcased 102 mining and mineral-processing projects at the First International Mines & Metals Investment Forum (Ministry of Mines & Metals, 1999).

Most proposed foreign investment contacts in the minerals sector were based on a buy-back scheme under which the contractors developed awarded projects for a contract-specified rate of return for a specified period after recovering their initial investment from the project's output. The Government had tailored the buy-back procedure to conform with Article 153 of the Iranian Constitution, which prohibited foreign control over natural resources (Corzine, 1998). During 2000, the Government evaluated various revisions to the buy-back procedure for petroleum operations to address published concerns that the current (2000) formula encouraged overproduction during the initial contract term, contrary to good reservoir management procedures and at the expense of long-term field production (Middle East Economic Digest, 2001c, p. 28).

The U.S. Government's Iran and Libya Sanctions Act of 1996 (ILSA) (Public Law 104-172), which proscribed any company (American or foreign) from exceeding a $20-million-per-year investment or trading limit with Iran in the petroleum sector, initially had hampered foreign investment in petroleum and other mineral industry projects in Iran. Since 1998, however, many European nations have reestablished official relations with Iran and have not discouraged investment in Iran.

In 1998, the U.S. Government waived sanctions against an international consortium that was developing the offshore South Pars gasfield (Middle East Economic Digest, 1998). In 1999 and 2000, the U.S. Government lifted the restrictions on the sale of spare parts for Iranian civilian passenger aircraft; modified the restrictions on the export of food, medicine, and medical equipment to Iran; and allowed the import of Iranian carpets and certain food products into the United States. The gradual reduction of restrictions lead to the anticipation that the U.S. Government would allow the ILSA to expire in 2001. Without ILSA, additional international companies would probably invest in the Iranian minerals sector (Middle East Economic Digest, 2001a; Oil & Gas Journal, 2001). In addition to ILSA, American citizens and companies were banned from investing or participating in Iran's mineral sector activities under Presidential Executive Orders 12957 of March 15, 1995, 12959 of May 6, 1995, and 13059 of August 19, 1997.

Structure of the Mineral Industry

The overall management of the minerals sector was under the auspices of the Ministry of Industry and Mines. The Ministry's authority covers all mining, smelting, and refining industries except oil and gas, which were administered by the Ministry of Petroleum. Most of the estimated 2,700 active mines were privately owned, although the State retained operational control of the larger companies in the minerals sector.

Commodity Review

Metals

Aluminum.—Primary aluminum production was, for the most part, derived from the Iranian Aluminium Co. plant in Arak. Commissioning of Al-Mahdi Aluminium Corp.'s aluminum smelter at Bandar Abbas slowly continued; only 60 of the plant's 240 pots had been brought online since the smelter's 1997 startup (Metal Bulletin 2000a). Construction continued at the 280,000-metric-ton-per-year-(t/yr)-capacity alumina refinery at Jajarm, about 480 kilometers (km) northeast of Tehran; delays were attributed to design problems (Iran Daily, September 5, 2000, Jajrom alumina plant back on track, accessed September 11, 2000, at URL http://www.iran-daily.com/4/).

Chromite.—Sepahan Steel Co. of Iran and international investors were to develop an 18,000-t/yr chromite mine at Abadeh. ABB Industrie AG of Switzerland, Evicom of Austria, Baft Ferrochrome Industrial Co. of Iran, and Navid Ehya Sepahan of Iran reportedly agreed to build a 25,000-t/yr ferrochrome plant in Baft in Kerman Province and a 25,000-t/yr ferrochrome plant at Abadeh in Fars Province. Construction of the plants was projected to take 2 years (Iran Daily, June 18, 2000, $74 million ferrochrome deal concluded, accessed June 19, 2000, at URL http://www.iran-daily.com/1; Iran Daily, August 1, 2000, Swiss firms invest in Abadeh chromite mine, accessed August 4, 2000, at URL http://www.iran-daily.com/2).

Copper.—Anglo Exploration GmbH of Germany and General Iranian Mining Co. of Iran explored for copper in Zarshuran and undertook regional exploration for copper, gold, and zinc. BHP Ltd. evaluated the porphyry copper deposit of the Jabal-Barez region in Hormozgan Province.

In 1999, Union Capital Ltd. of Australia explored the North-East Copperbelt with Ehya Sanaya Khorassan Co. of Iran. Identified copper prospects included the Halak Abad prospect in the northeast and the Hazy Kandy prospect in the northwest. Reconnaissance exploration of the Sistan-va-Baluchestan Province by Zarcan Minerals Inc. of Canada resulted in the acquisition of 15 exploration permits. Zarcan formed a joint venture with National Iranian Copper Industries Co. (NICICO) to explore the Kuh-e Lar prospect.

Construction continued at NICICO's Khatounabad copper smelter, 20 km from the Sar Cheshmeh copper complex in southeastern Iran. The 80,000-t/yr-capacity plant reportedly was 62% complete (Iran Daily, September 21, 2000, SCC production to double, accessed September 26, 2000, at URL http://www.iran-daily.com/4). A 12,000-t/yr copper plant was proposed for Meshkin-Shahr in Ardebil Province (Iran Daily, September 28, 2000, European banks grant 30m euros for copper plant, accessed October 2, 2000, at URL http://www.iran-daily.com/3). Also proposed was construction of copper mines at the Meiduk and the Songun prospects.

Gold.—Much of the gold recovered in Iran was a coproduct of NICICO's Sar Cheshmeh copper complex operations. Additional gold was recovered from the Mouteh Mine and from gold placer mines in the Neyshabour area.

Zarcan was exploring for gold on the Agh Darreh prospect in northwestern Iran and the Baluchestan project in southeastern Iran. On the Agh Darreh gold property, the Pouya Zarcan Agh Darreh Co. (the joint venture of Zarcan and IRAMCO Aluminum Raw Material Co.) completed a prefeasibility study and a reverse circulation drilling program.

Iron and Steel.—Numerous iron and steel projects were at various stages of planning or construction. Voest-Alpine Industrieanlagenbau GmbH & Co. was contracted to increase the capacity of National Iranian Steel Co.'s 3.5-million-metric-ton-per-year-(Mt/yr)-capacity beneficiation plant at the Gol-e-Gohar iron ore mine to 5.2 Mt/yr (Metal Bulletin, 2000c). Other projects included the expansion of Isfahan Steel Co.'s plant with the addition of a 150-metric-ton (t) electric-arc furnace and a third blast furnace (1.4-Mt/yr capacity) proposed to be in production by 2003. At Khorasan, the 550,000-t/yr rolling mill was completed. Proposed expansion plans at Khorasan included a 110-t electric-arc furnace and a billet caster. Also proposed were a 800,000-t/yr sponge iron plant at the Zamzam Steel Mill in Khuzestan Province, a 765,000-t/yr rolling mill at Zagros, and a 70,000-t/yr cast iron plant in Asadabad in Hamedan Province (Metal Bulletin, 2000d; Mining Journal, 2000; Iran Daily, August 20, 2000, Economy—Steel accord signed with China, accessed August 21, 2000, at URL http://www.iran-daily.com/1; Tehran Times, April 21, 2001, Isfahan steel mill output hits 2m-ton mark, accessed April 20, 2001, at URL http://www.tehrantimes.com/Description.asp?Da=4/21/01&Cat=9&Num=9).

During 2000, Azarbaijan Steel Co.'s Mianeh Steel complex in East Azarbaijan Province started production at its new rolling mill. The mill had a capacity of 550,000 t/yr of light sections and industrial and construction round bars [Iran Daily, December 25, 2000, An introduction to Azarbaijan still mill (Mianeh), accessed December 25, 2000, at URL http://www.iran-daily.com/daily.htm]. Installation of a 150,000-t/yr bar and section mill at Kerman Steel was underway. An 800,000-t/yr Midrex direct-reduced iron plant was under construction at Khuzestan Steel Complex in Ahwaz. Khuzestan's electric-arc furnaces were scheduled for rehabilitation (Metal Bulletin, 2000d).

In 1999, the Mobarakeh Steel plant expanded its mill's hot-rolled coil capacity to 3.1 Mt/yr from 2.5 Mt/yr. Planned further expansion would increase hot-rolled coil capacity to 4.1 Mt/yr. A sixth direct-reduced iron plant was proposed for Mobarakeh (Metal Bulletin, 2000d, 2001). Iran Ferrosilice Co. proposed to expand its total ferrosilicon production capacity by 50,000 t/yr with the construction of two new furnaces (Metal Bulletin, 2000c).

Lead and Zinc.—Most of the nation's lead and zinc production was derived from three mines—the Angouran, the Irankouh, and the Kushk. National Iranian Lead and Zinc Co.'s 40,000-t/yr-capacity lead smelter and Calcimine Co.'s 7,000-t/yr-capacity zinc smelter were at Angouran. In 2000, Calcimine started operations at its 5,000-t/yr Qeshm Zinc Melting Plant joint venture. Calcimine proposed to expand the production capacity at Angouran to 14,000 t/yr and at Qeshm to 10,000 t/yr (Iran Daily, July 11, 2001, Zinc ingot exported to India, accessed July 17, 2001, at URL http://www.iran-daily.com/5; Iran Daily, October 29, 2000, Promotional item—Calcimine Co., accessed October 30, 2000, at URL http://www.iran-daily.com/1).

In June 2000, a 28,000-t/yr-capacity zinc smelter was dedicated at the Kushk Mine, near Yazd (Iran Daily, June 8, 2000, Major zinc agreement to be inked, accessed June 12, 2000, at URL http://www.iran-daily.com/3).

Cominco Ltd. of Canada and Iran Zinc Mine Development Co. negotiated the formation of a joint venture to assess the feasibility of mining and leaching the zinc oxides of the Angouran zinc deposit and the building of a 100,000-t/yr zinc refinery (Cominco Ltd., 2000). Anzex Resources Ltd. of Canada secured the rights to evaluate the zinc sulfides at Angouran. The joint venture of General Iranian Mining (50%), Itok GmbH of Austria (25%), and Union Capital (25%) studied the proposed development of the Mehdiabad Zinc project as an open pit mine. The joint venture drilled and initiated environmental studies of the prospect.

Industrial Minerals

Cement.—Production capacity expansion of about 1 Mt/yr was underway in Iran. In 2000, the 100,000-t/yr Azadegan Cement Factory on Qeshm Island began operations. Cement plants were reportedly under construction in Darab and Bushehr (Bell and others, 2001, p. 166-167; Iran Daily, June 27, 2000, Cement production reaches 28 tons, accessed July 3, 2000, at URL http://www.iran-daily.com/5; Iran Daily, July 10, 2000, Qeshm cement factory goes on stream, accessed July 17, 2000, at URL http://www.iran-daily.com/6).

Fertilizer.—The Geology and Minerals Exploration Organization planned to set up a 50,000-t/yr potash fertilizer plant in the Khour region of Isfahan Province. National Petrochemical Co. (NPC) proposed a 400,000-t/yr ammonia plant and a 660,000-t/yr urea plant at the Petrochemical Economic Zone at Bandar Iman Khomeini. In Assaluyeh special economic/energy zone, NPC proposed to erect a fertilizer facility with production capacities of about 750,000 t/yr of ammonia and about 1.2 Mt/yr of urea. The Bandar Assaluyeh plant would use gas from the offshore South Pars Field (Stell, 2000; Iran Daily, November 2, 2000, New fertilizer plant to be tendered, accessed November 8, 2000, at URL http://www.iran-daily.com/5; Tehrantimes.com, September 6, 2000, New fertilizer plant to produce 50,000 tons potash annually, accessed April 21, 2001, at URL http://213.166.26.12/Detailview.asp?Keyword=minerals&Da=9/6/00&Cat=9&Num=13).

Stone.—Decorative or dimension stone quarries produced granite, marble, and travertine. Stone quarries accounted for about 20% of Iran's active solid mineral extraction operations. The Government encouraged investment in additional stone cutting and processing facilities and attempted to reduce wastage by limiting explosives use in dimension stone quarries.

Mineral Fuels

An extensive survey of the Iranian portion of the Persian Gulf known as the "Persian Carpet 2000" offshore seismic survey was underway. Initial distribution of data was expected in 2001. As more international oil companies contributed to the development of Iranian oil and gasfields, NIOC was able to focus its attention on deferred exploration opportunities. Recent reserve additions could move Iran even higher on the list of countries with significant oil reserves. In 1999, the discovery of the 26-Gbbl Azadegan Field was announced (Mehrdad Balali, September 29, 1999, Iran makes massive $100bn oil find, accessed September 29, 1999, at URL http://www.headlines.co.za/news/sp99/iranoil29.htm). In 2000, reserves of 1 Gbbl were attributed to the Changuleh prospect (Iran Daily, September 13, 2000, New oil finds, accessed September 18, 2000, at URL http://www.iran-daily.com/4). Additional discoveries in 2000 included the Arash and the Ilam oilfields. As with many other Gulf States, Iran planned to increase production capacity. The proposed 1-Mbbl/d increase would be subject to quotas of the Organization of the Petroleum Exporting Countries (Middle East Economic Digest, 2001c).

On the natural gas front, NIOC announced the discovery of the Tabnak gasfield with reserves of 445 billion cubic meters of gas and 240 million barrels (Mbbl) of condensate, the Homa gasfield with reserves of 190 billion cubic meters of gas and 82 Mbbl of condensate, the Zireh gasfield with reserves of 23 billion cubic meters of gas, the Kerenj gasfield, and the Tosan gasfield (Oil & Gas Journal, 2000a; Iran Daily, August 21, 2000, Iran declares another energy discovery, accessed August 21, 2000, at URL http://www.iran-daily.com/daily.shtml; Petrodata Ltd., August 14, 2000, Petrodata daily upstream—Iran announces onshore gas field discovery, accessed August 14, 2000, at URL http://www.petrodata.co.uk/CGI/tbcgi.exe?CGILATEST).

During 2000, construction began on the 72-km, 142-centimeter-diameter dry gas pipeline that would connect the onshore South Pars gas facilities at Assaluyeh to the third transcountry gas pipeline (Iran Daily, March 8, 2000, Construction of South Pars gas pipeline starts, accessed March 15, 2000, at URL http://www.iran-daily.com/6).

A significant proportion of produced natural gas was reinjected. The Government proposed to terminate all gas flaring by the end of the 35-year economic development plan. Many of Iran's mature oilfields had reservoir pressure maintenance problems and were candidates for gas injection.

Plans to construct a 6- to 7.5-Mt/yr liquefied natural gas plant were proposed by a consortium of Indian, Iranian, and Malaysian companies and by the joint venture of BG International and Oil Industries Engineering and Construction Co. of Iran (BG International, 2000; Iran Daily May 21, 2000, Consortium to build $3.5b Iranian LNG plant, accessed May 22, 2000, at URL http://www.iran-daily.com/1).

For more extensive coverage of the natural gas and petroleum industry of Iran, see the U.S. Energy Information Administration Iran country analysis brief at URL http://www.eia.doe.gov/emeu/cabs/iran2.html.

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Major Sources of Information

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TABLE 1
IRAN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/ 3/

(Metric tons unless otherwise specified)

Commodity 4/	1996	1997 e/	1998	1999	2000 e/
METALS					
Aluminum:					
Bauxite, gross weight	150,000	150,000	336,000	912,451	400,000
Metal, primary ingot	80,100	92,300	123,759	137,421	140,000
Arsenic, orpiment and realgar, concentrates e/	500	492	323 r/	300 r/	400
Chromite, mine output, concentrate 5/					
Gross weight	130,220	168,984 6/	313,937	311,235	310,000
Cr_2O_3 content e/	63,800	82,800	138,000	137,000	137,000
Copper:					
Mine output:					
Ore mined (1% to 1.2% Cu):					
Gross weight thousand tons	14,150	14,200	13,740	13,770	13,800
Cu content e/	120,000	117,000	137,000	138,000	138,000
Concentrate (29% to 35% Cu):					
Gross weight e/	320,000	320,000	378,504 6/	381,346 6/	350,000
Cu content	108,000 e/	108,000	128,300	131,000	120,000
Metal:					
Smelter output, blister/anode	99,100	99,000	150,000	154,000	154,000
Refined output, cathode	99,200	103,300	129,000	131,700	132,000
Gold, mine output, Au content 7/ kilograms	640	684 6/	856	930	950
Iron and steel:					
Ore and concentrate:					
Gross weight thousand tons	9,850	12,750	10,536	10,776	11,000
Fe content e/ do.	4,800	6,300	5,200	5,300	5,400
Metal:					
Pig iron do.	1,867	2,053 6/	2,087	2,147	2,200
Direct-reduced iron do.	3,778	4,380 6/	3,690	4,120	4,740
Ferrochromium	10,500	11,450 6/	13,745	13,680	14,000
Ferrosilicon e/	40,000 r/	40,000 r/	40,000 r/	46,000 r/	40,000
Steel, crude, ingots and castings thousand tons	5,415	6,322 6/	5,608	6,277	6,600
Lead:					
Mine output, concentrate:					
Gross weight e/	30,000	37,000	21,216 6/	22,000	27,000
Pb content	15,700 e/	18,200	11,000	11,000 e/	15,000
Refinery output, includes secondary	46,900	49,400	47,000	47,000 e/	47,000
Manganese, mine output, (30% to 35% Mn):					
Gross weight	100,000	135,000	101,390	104,096	105,000
Mn content e/	32,000	40,000	30,500	32,000 r/	32,000
Molybdenum, mine output, concentrate (56% Mo): e/					
Gross weight	1,600	1,800	4,350 6/	4,906 6/	4,900
Mo content	560	600	1,400	1,600	1,600
Silver, mine output, Ag content e/	40	30	19 6/	21 6/	22
Zinc:					
Mine output, concentrate:					
Gross weight e/	152,000	132,000	160,000	160,000	170,000
Zn content	76,300	76,500	80,000 e/	80,000 e/	85,000
Metal e/	--	14,000	23,000	23,000	50,000
INDUSTRIAL MINERALS					
Asbestos: e/					
Concentrate, (3% to 8% marketable fiber)	65,000	86,200	45,000	40,000	40,000
Marketable fiber	4,500	4,300	2,258 6/	2,000	2,000
Barite	150,000 e/	181,174 6/	187,677	183,850	185,000
Boron, borax e/	500	420	2,086 6/	3,663 6/	3,700
Cement, hydraulic e/ thousand tons	18,350	19,250	19,500 r/	22,080 r/ 6/	23,880 6/
Clays:					
Bentonite	85,000	105,300 6/	83,279 6/	64,957	70,000
Other: e/					
Industrial clays	300,000	350,000	450,000	400,000	450,000
Kaolin	350,000	478,964 r/ 6/	582,485 6/	837,277 6/	800,000
Total	650,000	828,964 r/	1,030,000	1,237,000	1,250,000
Diatomite e/	90	90	600	4,350	4,500
Feldspar	106,000	125,000 6/	185,709	239,779	240,000
Fluorspar	20,000 e/	24,846 r/ 6/	25,904	18,387	20,000

See footnotes at end of table.

TABLE 1--Continued
IRAN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/ 3/

(Metric tons unless otherwise specified)

Commodity 4/	1996	1997 e/	1998	1999	2000 e/
INDUSTRIAL MINERALS--Continued					
Gemstones, turquoise e/ kilograms	5,000	14,000 r/ 6/	6,000 6/	20,000	20,000
Gypsum thousand tons	8,570	9,966 r/ 6/	11,843	10,834	11,000
Industrial or glass sand (quartzite and silica) e/	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Lime e/ thousand tons	2,000 r/	2,500 r/ e/	2,737 r/ 6/	2,138 r/ 6/	2,200
Magnesite e/	55,000	119,000 r/ 6/	109,597 6/	141,081 6/	141,000
Mica e/	1,000 r/	1,086 r/ 6/	1,084 6/	1,425 6/	2,000
Nitrogen content of ammonia	882,000	879,800 6/	1,034,000	865,000 r/	965,000 6/
Nitrogen content of urea	552,900	610,500 6/	800,000 e/	800,000 e/	800,000
Perlite e/	6,000	10,000	13,320 6/	15,069	15,000
Pigments, mineral, natural iron oxide, ochre e/	2,500	10,000 r/	13,300 r/	13,300 r/	13,500
Pumice and related volcanic materials e/	200,000	200,000	150,000	150,000	150,000
Salt	1,000,000 e/	1,180,000	1,911,800 6/	1,600,000	1,600,000
Sodium compound, caustic soda e/	15,000	15,000	20,000	20,000	20,000
Stone: e/					
Construction and building, crushed, n.e.s. thousand tons	4,800	14,828 r/ 6/	11,670 r/ 6/	11,000 r/	12,000
Dimension and decorative:					
Granite do.	150 r/ e/	195 r/ 6/	181 6/	195 6/	200
Marble:					
Blocks do.	4,500	4,500	6,000	6,400	7,000
Crushed do.	450	450	500	500	550
Slabs do.	50	50	100	100	110
Travertine:					
Blocks do.	500	550 r/	516 6/	435 6/	500
Crushed and slabs do.	70	70	100	65	100
Total do.	5,720 r/	5,815 r/	7,400 r/	7,700 r/	8,500
Dolomite do.	200	267 r/ 6/	475	286 6/	300
Limestone do.	32,000	33,000	33,000	33,000	35,000
Strontium, celesite e/	2,000 r/	2,000 r/	2,000 r/	1,650 6/	2,000
Sulfates, natural: e/					
Aluminum potassium sulfate (alum)	12,000	12,000	12,000	12,000	12,000
Sodium sulfate	315,000 6/	480,000	264,973	308,093	300,000
Sulfur: e/					
Byproduct of petroleum and natural gas	840,000	850,000	1,280,000	1,302,000	1,300,000
Byproduct of metallurgical processing, S content of acid	50,000	50,000	50,000	48,000	50,000
Total	890,000	900,000	1,330,000	1,350,000	1,350,000
Talc e/	20,000	29,660 r/ 6/	27,038 r/ 6/	25,000 r/	25,000
MINERAL FUELS AND RELATED MATERIALS					
Coal thousand tons	1,840	1,750	1,711	1,507	1,500
Coke e/ do.	700	800	22,000 6/	20,000	25,000
Gas, natural:					
Gross million cubic meters	86,000	82,600	89,000	90,600 e/	120,000
Dry do.	39,077	47,000	50,000	51,000 e/	55,000
Natural gas plant liquids e/ thousand 42-gallon barrels	23,500	22,000	23,000	24,000	25,000
Petroleum:					
Crude do.	1,345,390	1,337,360 6/	1,325,000	1,300,000 e	1,360,000
Refinery products: e/					
Liquefied petroleum gases do.	23,000	14,500	15,700	15,000	16,000
Motor gasoline do.	54,400	54,500	65,700	60,000	65,000
Jet fuel do.	10,200	10,000	13,000	11,000	12,000
Kerosene do.	35,800	36,000	40,000	36,000	40,000
Distillate fuel oil do.	108,800	109,000	136,000	120,000	140,000
Residual fuel oil do.	98,600	98,000	163,000	140,000	160,000
Other do.	64,200	64,000	61,000	60,000	67,000
Total do.	395,000	386,000	494,400	442,000	500,000

e/ Estimated. r/ Revised.

1/ Table includes data available through August 31, 2001.

2/ Data are for Iranian years ending March 21 of that stated, except data for natural gas, plant liquids, and petroleum, which are for Gregorian calendar years.

3/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

4/ In addition to commodities listed, the following may have been produced, but information in inadequte to estimate output: ferromanganese, ferromolybdenum, nepheline syenite, phosphate rock, selenium, shell, vermiculite, and zeolite.

5/ Chromite content of concentrate estimated to be 48% to 50% Cr_2O_3 for 1995 through 1997 and 42% to 45% Cr_2O_3 for 1998 and 1999.

6/ Reported figure.

7/ Includes gold recovered from the Mouteh gold mine and from the Sarcheshmeh copper complex.

TABLE 2
IRAN: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Aluminum	Iran Aluminium Co. (Government)	Arak	120
Do.	Al-Mahdi Aluminium Corp. (National Iranian Copper Industrie Co., 33.32%, International Development Corp., 18.9%; Iran Aluminium Co., 13.9%; Maydook Copper Co., 11.95%)	Bandar Abbas	110
Do.	Qeshm Aluminium Co. (Prime International Ltd.)	Qeshm Island Free Trade Area	NA
Arsenic metric tons	NA	Zarshuran Mine, Tabak	440
Barite	Iran Barite Falat Co.	Lar Mine, Tehran	46
Do.	do.	Elit Mine, Amol	21
Do.	do.	Dasht-E-Deh Mine, Kavir Dar Anjir	12
Do.	do.	Haji abad Mine; Komsheh Cheh Mine; Kashan, Ardekan Mine; Djasb Mine; and Vardeh Mine	18
Do.	Other companies	Other mines	148
Boron	NA	Gharagol Mine, Tabak	2,800
Cement	Abadeh Cement Co.	Abedeh	NA
Do.	Abyek Cement Co. (Fars & Khouzestan Cement Co.)	Abyek, 80 kilometers northwest of Tehran	2,300
Do.	Ardebil Cement Co. (Ehdasse Sanat Corp.)	About 20 kilometers from Ardebil	840
Do.	Azadegan Cement Factory	Qeshm Island	100
Do.	Behbahan Cement Co. (Fars & Khouzestan Cement Co.)	Behbahan	880
Do.	Bojnourd Cement Plant	Bojnourd	700
Do.	Bushehr Cement Co. (Ehdasse Sanat Corp.)	Borazjan	1,100 3/
Do.	Darab Cement Co. (Ehdasse Sanat Corp.)	Near Shiraz	1,100 3/
Do.	Doroud Cement Co. (Fars & Khouzestan Cement Co.)	Doroud	1,440
Do.	Ekbatan Cement Co.	Ekbatan	NA
Do.	Estahban Cement Co.	Estahban	NA
Do.	Fars Cement Co. (Fars & Khouzestan Cement Co.)	Fars	1,050
Do.	Ghaen Cement Co. (Iran National Industrial Organization)	Ghaen	600
Do.	Gharb Cement Co.	Kermanshah	640
Do.	Gorgon Cement Co.	NA	640
Do.	Hegmatan Cement Co. (Ehdasse Sanat Corp.)	East of Razan	840
Do.	Hormozgan Cement Co. (Ehdasse Sanat Corp.)	About 52 kilometers west of Bandar Abbas	2,200
Do.	Ilam Cement Co.	Ilam	NA
Do.	Isfahan Cement	Isfahan	710
Do.	Karoon Cement Co.	Karoon	NA
Do.	Kerman Cement Co.	Kerman	1,150
Do.	Khash Cement Co. (Ehdasse Sanat Corp.)	Khash	730
Do.	Khazar Cement Co.	Khazar	640
Do.	Khouzestan Cement Co. (Ehdasse Sanat Corp.)	Ramhormoz	1,100
Do.	Kordestan Cement Co. (Ehdasse Sanat Corp.)	North of Bijar	800
Do.	Mazandaran Cement Co.	Neka	NA
Do.	Meshed Cement Co.	Meshed	500
Do.	Ourmia Cement Co.	Uroumiyeh	740
Do.	Ourmia White Cement Co.	do.	180
Do.	Nyriz White Cement Co.	Nyriz	NA
Do.	Saveh White Cement Co.	Saveh	180
Do.	Sepahan Cement Co.	Sepahan	2,100
Do.	Shahroud Cement Co.	Sharoud	NA
Do.	Sharg Cement Co.	Mashhad	NA
Do.	Shomal Cement Co.	Shomal	880
Do.	Shomal White Cement Co.	do.	NA
Do.	Simansaz Cement Co.	Loshan	100
Do.	Sufiyan Cement Co.	Sufiyan	1,500
Do.	Tabriz Cement Co.	Tabriz	NA
Do.	Tehran Cement Co.	Tehran	3,000
Do.	Yazd Bohrouk Cement Co.	Yazd	NA
Do.	Yazd White Cement Co.	Hemgaman	NA
Chromite	Faryab Mining Co.	Faryab Mine, Minab, Hormuzgan	180
Do.	NA	Mine at Esfandaqeh	30
Do.	NA	Forumad Mine, Mayami, Semnan	6
Do.	NA	Mir Mahmud Mine, Mayami, Seman	6
Do.	NA	Bandan Mine, Khorasan	5
Do.	NA	Mokki Mine, Zahedan	4
Do.	NA	Nok Abad, Zahedan	3
Do.	NA	Gaft Mine, Khorasan	2

See footnotes at end of table.

TABLE 2--Continued
IRAN: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Chromite--Continued:	Other companies	Other mines	21
Clay:			
Bentonite	Iran Barite Falat Co.	Mehrijan Mine, Farrokhi, Esfahan	39
Do.	do.	Zarrin Mine, Kavir Dar Anjir, Yazd	3
Do.	Other producers	Other mines	121
Industrial and fire clay	Iranian Refractory Procurement and Production	Mine and plant, Tehran	40
Do.	Other producers	Other mines	1,117
Kaolin	Khorasan Kaolin Co.	Shurkesht Mine, Sabzevar, Khorasan	50
Do.	do.	Mine (inactive) at Torbat Hydarieh, Khorasan	20
Do.	do.	Plant at Torbat Hydarieh, Khorasan	20
Do.	Other companies	Other mines	700
Coal	Iran Foulad Co.	Paradeh 3 Mine, Tabass, Khorasan	14
Do.	Kerman Coal Co. [National Iranian Steel Company (Nisco)]	Various mines	854
Do.	Central Alborz Coal Co. (Nisco)	Zirab, Mazandaran	NA
Do.	Eastern Alborz Coal Co. (Nisco)	Shahroud, Mazandaran	NA
Do.	do.	Razi coal mine, Semnan	39
Do.	Western Alborz Coal Co. (Nisco)	Near Sangroud, Gilan	NA
Total			641
Do.	NA	East Mazinoo and West Mazinoo, Khorasan	4
Coal tar	Isfahan Coal Tar Refinery	Refinery 40 kilometers east of Esfahan	100
Cobalt	NA	Eglide Mine, Fars	NA
Coke	Isfahan Steel Co. (Nisco)	Isfahan complex 40 kilometers east of Esfahan	1,150
Copper	National Iranian Copper Industries Co. (Government)	Sar Cheshmeh Mine 60 kilometers south of Rafsanjan	13,400
Do.	do.	Songun copper mine	400 3/
Do.	do.	Meiduk copper mine	5,000 3/
Do.	do.	Qal'eh Zari Mine near Birjan	15
Do.	do.	Smelter, Sar Cheshmeh copper complex	154
Do.	do.	Smelter, Khatounabad	80 3/
Do.	do.	Refinery, Sar Cheshmeh copper complex	120 4/
Do.	do.	Electrowon plant, Sar Cheshmeh copper complex	12 4/
Do.	do.	Rolling mill (billet), Sar Cheshmeh copper complex	3
Do.	do.	Rolling mill (slab), Sar Cheshmeh copper complex	7
Do.	do.	Wire rod plant, Sar Cheshmeh copper complex	51
Do.	Shahid Bahonar Copper Industries Co. (Social Security Investment Co.)	Mill at Kerman	35
Do.	Simco.	Wire plant at Rasht	NA
Copper, secondary	Niru Metal Smelting Factory (Niru Battery Manufacturing Co.)	Ghani Abad Factory, Tehran	NA
Diatomite	NA	Kamel Abad, Tabriz	2
Ferroalloys:			
Ferrochromium	Faryab Mining Co.	Faryab, Kerman	15
Ferromanganese	Navid Manganese Co.	NA	15
Do.	Faryab Mining Co.	Kerman	15
Ferromolybdenum	Pars Molybdenum Co.	NA	1
Do.	National Iranian Copper Industries Co. (Government)	Khatounabad smelter	2
Do.	Zanjan Bronze	NA	1
Ferrosilicon	Iran Ferrosilice Co.	Azna, Semnan	25
Do.	Iran Ferroalloy Ind.	NA	23
Do.	Navid Alyaj Co.	NA	1
Fertilizer:			
Ammonia	Razi Petrochemical Co. (National Petrochemical Co.)	Bandar Iman Khomeini	660
Do.	Shiraz Petrochemical Co. (National Petrochemical Co.)	Southeast of Shiraz	432
Do.	Khorasan Petrochemical Co. (National Petrochemical Co.)	Khorasan Province	330
Diammonium phosphate	Razi Petrochemical Co. (National Petrochemical Co.)	Bandar Iman Khomeini	240
Urea	do.	do.	726
Do.	Shiraz Petrochemical Co. (National Petrochemical Co.)	Southeast of Shiraz	543
Do.	Khorasan Petrochemical Co. (National Petrochemical Co.)	Khorasan Province	495
Fluorspar	NA	Kamar Mehdi Mine 165 kilometers southwest of Tabas	20
Do.	NA	Emaft Mine 30 kilometers from Zirab, Mazandaran	3
Do.	NA	Helali Gonabad Mine 27 kilometers from Gonabad-Bajestan road	2
Do.	NA	Delijan region mines 10 kilometers from Delijan, Markazi	6
Do.	NA	Kamarposht Mine 20 kilometers from Zirab	5

See footnotes at end of table.

TABLE 2--Continued
IRAN: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Fluorspar--Continued:	NA	Mahalat Mine 5 kilometers from Mahalat, Markazi	2
Do.	NA	Pachi Miyana Mine 30 kilometers from Zirab	2
Do.	NA	Jouimand Mine 23 kilometers northwest of Gonabad, Khorasan	NA
Do.	NA	Derasele deposit	NA
Gemstones, turquoise	NA	Neyshabour Mine	6
Gold, ore kilograms	NA	Moteh Mine, Esfahan	500
Do. do.	Iranian Gold Co.	Cengedeh operation	128
Do. do.	Artisanal placer operations	Neyshabour area	NA
Gold 4/ do.	National Iranian Copper Industries Co.	Sar Cheshmeh	500
Gypsum	Private owner	Semnan-Mazandran Mine, Semnan	476
Do.	do.	Saran 2 Mine, Tehran	181
Do.	do.	Zevan Mine, Semnan	171
Do.	do.	Saran 1 Mine, Tehran	134
Do.	do.	Aftar Mine, Semnan	130
Do.	do.	Momenabad Mine, Semnan	118
Do.	Other producers	Various mines	8,154
Iron:			
Ore	Gol-e-Gohar Iron Ore Co. (Nisco)	Gol-e-Ghar Mine, Kerman	5,200 3/
Do.	Chadormalou Mining and Industrial Co. (Nisco)	Chadormalou Mine 90 kilometers north of Tchogart	3,800
Do.	Iran Central Iron Ore Co. (Nisco)	Choghart Mine, Bafgh, Yazd	3,250
Do.	NA	Sangan Mine, Golestan	100
Do.	Iran Barite Falat Co.	Deh-Zaman Mine, Khorassan	4
Do.	Ajin Iron Mining Co.	NA	NA
Metal	Mobarekeh Steel Co. (Nisco)	Direct reduction iron plant (Midrex process) at Esfahan	3,200
Do.	Khuzestan Steel Co. (Nisco)	Direct reduction iron plant (HYL I, Midrex 3, and Purofer processes), Ahwaz	2,230
Do.	Isfahan Steel Co. (Nisco)	Direct reduction iron plant (Ghaem process) at Esfahan	600 6/
Lead:			
Ore	Iran Zinc Mine Development Co.	Angouran Mine, Zanjan	450 7/
Do.	Bama Mining Co.	Irankouh Mine, Esfahan	290 7/
Do.	National Iranian Lead and Zinc Co.	Kushk Mine, Yazd	175 7/
Do.	do.	Douna Mine	38
Do.	do.	Nakhlak Mine 60 kilometers northeast of Anarak	25
Do.	do.	Emarat Mine, Markazy	NA
Do.	do.	Ravanj Mine, Markazy	NA
Metal	do.	Smelter at Zanjan	40
Do.	do.	Refinery at Zanjan	40
Do.	do.	Refinery at Naklak	NA 8/
Lead, secondary	Niru Metal Smelting Factory (Niru Battery Manufacturing Co.)	Tehran	40
Lime	National Iranian Copper Industries Co.	Sarcheshmeh Copper Complex	NA
Do.	Ardebil Cement Co.	Azarshahr Lime Plant	NA
Manganese	Iran Manganese Mines Co.	Venarch Manganese Mine, Qom	70
Do.	Qom Manganese Mines Co.	Shahrestouak Mine, Qom	3
Methanol	Kharg Petrochemical Co. (National Petrochemical Co.)	Kharg Island	660
Do.	Shiraz Petrochemical Co. (National Petrochemical Co.)	Shiraz	100
Do.	Fanavaran Petrochemical Co. (National Petrochemical Co.)	Bandar Imam	1,000 3/
Mica metric tons	Private owner	Qareh Bagh Mine, Uroumiyeh region	1,386
Do. do.	do.	Other mines	320
Molybdenum	National Iranian Copper Industries Co.	Sarcheshmeh Copper Complex	NA
Natural gas:			
Production 9/ billion cubic meters	National Iranian Gas Co. (Government)	Kangan	21
Do. do.	do.	Nar	17
Do. do.	do.	Dalan	8
Do. do.	do.	Aghar	6
Processing do.	do.	Vali Asr gas refinery 40 kilometers from Bandar Taheri	38
Do. do.	do.	Sarkhoun-2 near Bandar Abbas	4
Do. do.	do.	Dalan	13
Do. do.	do.	Khangiran	8
Do. do.	do.	Bid Boland	NA
Do. do.	do.	Qeshm Island	NA

See footnotes at end of table.

TABLE 2--Continued
IRAN: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Natural gas--Continued:			
Processing--Continued: billion cubic meters	National Iranian Gas Co. (Government)	Marun-4	NA
Do. do.	do.	Ahwaz	1
Liquids million 42-gallon barrels	do.	NGL 1200, Gachsaran	9 3/
Do. do.	do.	Ahwaz	7
Do. do.	do.	NGL 1300, Siyah Makan	6 3/
Do. do.	do.	Lavan	NA 3/
Peat metric tons	Private owner	Mazandaran	1,430
Perlite do.	do.	Miyaneh Mine, Tabriz	7,000
Do. do.	do.	Shahriyar Mine, Tabriz	5,000
Do. do.	Private owners	Other operations	8,400
Petroleum:			
Crude production million 42-gallon barrels	National Iranian Oil Co. (NIOC) (Government)	Ahwaz Asmari Field	292
Do. do.	do.	Gachsaran Field	219
Do. do.	do.	Marun Field	208
Do. do.	do.	Agha Jari Field	69
Do. do.	do.	Ahwaz Bangestan Field	58
Do. do.	do.	Bibi Hakimeh Field	55
Do. do.	TotalElfFina Group (55%), Agip (45%)	Doroud Field, offshore	53
Do. do.	NIOC	Abouzar Field, offshore	46
Do. do.	do.	Karanj Field	46
Do. do.	do.	Rag-e-Safid Field	37
Do. do.	do.	Salman Field, offshore	31
Do. do.	TotalElfFina Group (70%), Petronas (30%)	Sirri E Field, offshore	31
Do. do.	NIOC	Pazanan Field	29
Do. do.	do.	Mansuri Field	22
Do. do.	do.	Kupal Field	20
Do. do.	do.	Nargesi Field	18
Do. do.	do.	Binak Field	18
Do. do.	do.	Ab-Teymur Field	16
Do. do.	do.	Haft Kel Field	15
Do. do.	do.	Lab-e-Safid Field	15
Do. do.	do.	Cheshmeh Khush Field	14
Do. do.	do.	Forozan Field, offshore	13
Do. do.	do.	Ramshir Field	11
Do. do.	do.	Naft Safid Field	9
Do. do.	do.	Sirri C and Sirri D Fields, offshore	9
Do. do.	do.	Bahregansar Field, offshore	7
Do. do.	Total (70%), Petronas (30%)	Sirri A Field, offshore	7
Do. do.	NIOC	Shadegan Field	7
Do. do.	Iranian Offshore Engineering & Construction Co.	Soroosh Field, offshore	7
Do. do.	NIOC	Resalat and Reshadat Fields, offshore	5
Do. do.	do.	Naft-Shahre Field	5
Refined products do.	National Oil Refining and Distribution Co.	Abadan	164
Do. do.	do.	Esfahan	97
Do. do.	do.	Bandar Abbas	85
Do. do.	do.	Tehran	82
Do. do.	do.	Arak	55
Do. do.	do.	Tabriz	41
Do. do.	do.	Shiraz	15
Do. do.	do.	Kermanshah	11
Do. do.	do.	Lavan	7
Phosphate rock	Phosphate Mines Development Co.	Esfordi Mine, Yazd	141
Do.	Other companies	Other mines	29
Pozzolan	Private owner	Keshavarz Mine	39
Do.	Other companies	Other mines	105
Salt:			
Rock	Private owner	Melhe Mine, Semnan	116
Do.	do.	Khohdasht Kohan Mine, Semnan	95
Do.	do.	Salar Mine, Semnan	54

See footnotes at end of table.

TABLE 2--Continued
IRAN: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Salt--Continued:			
Rock--Continued:	Private owner	Gaem Mine, Semnan	37
Do.	Other companies	Other mines	419
Solar	Bandar Imam Petrochemical Co. (National Petrochemical Co.)	Bandar Iman Khomeini operation, Khouzestan	400
Do.	Shiraz Petrochemical Co. (National Petrochemical Co.)	Maharlo Shiraz facility, Fars	352
Do.	Private owner	Gavehkoni Mine, Esfahan	42
Do.	Other companies	Other operations	91
Silver	National Iranian Lead & Zinc Co.	Zanjan lead smelter, Zanjan	12
Steel:			
Crude	Mobarekeh Steel Co. (Nisco)	Steel plant near Esfahan	3,100
Do.	Isfahan Steel Co. (Nisco)	Steel plant at Esfahan	1,940
Do.	Iran National Steel Industrial Group (Nisco)	Steel plant at Ahwaz	1,000
Do.	Khuzestan Steel Co. (Nisco)	do.	1,000
Do.	Khorasan Steel Co. (Nisco)	Steel plant at Neyshabur	600 3/
Do.	Iran Alloy Steel Co (Nisco, 63%; Bank Saderat Iran, 37%)	Yazd steel plant	250
Rolling mills	Mobarekeh Steel Co. (Nisco)	Rolling mills (hot strip) at Esfahan	3,100
Do.	do.	Rolling mills (cold reduction) at Esfahan	875
Do.	Saveh Rolling and Profile Mills Co.	Pipe and section mill at Saveh	805
Do.	Kaavian Steel Co. (Nisco)	Rolling mills	800
Do.	Isfahan Steel Co. (Nisco)	Rolling mill (medium sections) at Esfahan	700
Do.	do.	Rolling mill (light sections) at Esfahan	700
Do.	Ahwaz Rolling & Pipe Mills Co. (Government)	Rolling mill mill at Ahwaz	600
Do.	Esfahan Steel Co. (Nisco)	Rolling mill (heavy sections) at Esfahan	550
Do.	Khorasan Steel Co. (Nisco)	Rolling mill at Khorasan	550
Do.	Mianeh Steel Plant (Azarbaijan Steel Co.)	Rolling mill in East Azarbaijan	550
Do.	Khuzestan Steel Co. (Nisco)	Rolling mill at Ahwaz	540
Do.	Iran Alloy Steel Co (Nisco, 63%; Bank Saderat Iran, 37%)	Rolling mill (heavy sections) at Yazd	210
Do.	Sepahan Industrial Group Co.	Tube and pipe mill at Esfahan	200
Do.	Kerman Steel Co.	Bar and section mill	150 3/
Do.	Iran Alloy Steel Co (Nisco, 63%; Bank Saderat Iran, 37%)	Rolling mill (light sections) at Yazd	145
Do.	Iran Spiral Co.	Tube and pipe mill (41 to 305 centimeters diameter) at Esfahan	120
Do.	Isfahan Steel Co. (Nisco)	Wire rod plant at Esfahan	120
Do.	Ahwaz Rolling & Pipe Mills Co.	Tube and pipe mill (0.1 to 15 centimeters diameter) at Ahwaz	80
Do.	Kalup Co.	Tube and pipe mill (15 to 36 centimeters diameter) at Saveh	60
Stone, sand and gravel: 10/			
Dolomite	Private owners	Sundry quarry operations	300
Granite metric tons	Private owner	Tavandasht Mine, Lorestan	3,000
Do. do.	do.	Gasaban Mine, Hamedan	800
Do. do.	Private owners	Other operations	243,000
Do. square meters	Saeid Granite Co.	Stone processing factories at Ghorveh and Tehran	60,000
Limestone	Private owner	Bibisharhbani Mine, Tehran	1,700
Do.	do.	Chelleh Kaneh Mine, Tabriz	1,500
Do.	do.	Lashtegan Mine, Hormozgan	1,200
Do.	do.	Pirbakran Mine, Esfahan	1,110
Do.	do.	Asmari Mine, Khouzestan	1,000
Do.	do.	Kash Mine, Sistan & Baluchestan	890
Do.	do.	Doroud Mine	830
Do.	do.	Karzan Mine, Ilam	760
Do.	do.	Shiraz Mine, Fars	720
Do.	do.	Ablou Mine, Mazardaran	670
Do.	do.	Hozmahi Mine, Esfahan	470
Do.	do.	Chenareh Mine 200 kilometers from Khoramshahr City	300
Do.	Private owners	Various other quarry operations	31,100
Marble	Private owner	Tangeh Hanna E Nyriz Mine, Fars	8,000
Do.	do.	Libeed Mine, Esfahan	1,100
Do.	do.	Chahsavar South Nyriz Mine, Fars	600
Do.	do.	Lashtar Mine, Esfahan	445
Do.	do.	Asgaran Mine, Lorestan	320
Do.	do.	Aligodare Mine, Lorestan	270
Do.	do.	Gadamgah Mine, Hormozgan	190

See footnotes at end of table.

TABLE 2--Continued
IRAN: STRUCTURE OF THE MINERAL INDUSTRY IN 2000 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Stone, sand and gravel--Continued: 10/			
Marble--Continued:	Private owner	Hetnabad Mine, Esfahan	220
Do.	Ahjar Dehbid Com., Co.	Dehbid Mines, Fars	180
Do.	Private owner	Jashegangali Mine, Esfahan	120
Do.	do.	Darbehchah Mine, Lorestan	119
Do.	do.	Najafabad Mine, Esfahan	46
Do.	do.	Gavoshani Mine, Jordestan	27
Do.	do.	Falard Mine, Shahrekord	21
Do.	do.	Sirjan Mine, Kerman	20
Do.	do.	Doroud Mine, Lorestan	9
Do.	do.	Gohareh Mine, Kermanshah	8
Do.	Private owners	Various other quarry operations	2,500
Do.	NA	Stone cutting facilities at the Sangal-e-Nyriz complex	NA
Onyx	Private owner	Sefied Koh Mine, Yazd	7
Do.	do.	Borg Mine, Yazd	5
Do.	do.	Deh rostan Mine, Kerman	4
Do.	Private owners	Various other quarry operations	54
Silica and silica sand	do.	Various sand pit operations	1,719
Travertine	Private owner	Hajiabad Mine, Arak	118
Do.	do.	Targ Mine (Natanz), Esfahan	22
Do.	do.	Vargoran Targ Mine (Natanz), Esfahan	19
Do.	do.	Alvan Varton Mine, Esfahan	10
Do.	Private owner	Nadinlou Mine (Azarshahr), Tabriz	10
Do.	do.	Colvanag 1 Mine, Tabriz	10
Do.	do.	Sardarabad Mine, Tabriz	10
Do.	do.	Colvanag 2 Mine, Tabriz	8
Do.	Private owners	Other operations	365
Do.	NA	Travertine cutting complex at Sangal-e-Azarshahr	NA
Sulfur:	National Oil Refining and Distribution Co.	Abadan, Bandar Abbas, Tehran, Isfahan, Arak, Tabriz	NA
Do.	National Petrochemical Co.	Kharg Chemical Complex, Kharg Island	216
Do.	National Iranian Gas Co.	Various gas plants	NA
Talc	Private owner	Deh Haji Mine, Lorestan	10
Do.	do.	Other operations	12
Vermiculite	NA	Mohmmad abad Klaybar	2
Zeolite	Private owner	Aftar Mine, Semnan	10
Do.	do.	Mjyaneh Mine, Tabriz	10
Do.	do.	Amir Abad Mine, Tabriz	8
Do.	do.	Abeh Garm, Semnan	6
Zinc:			
Ore	Iran Zinc Mine Development Co.	Angouran Mine, Zanjan	450 7/
Do.	BAMA Co.	Irankouh (Goushfil, Tapeh Sorhk, and Kolah Darvazeh pits) Mine, Esfahan	290 7/
Do.	National Iranian Lead & Zinc Co.	Kushk Mine, Yazd	175 7/
Do.	Bafgh Mining Co.	NA	25
Do.	National Iranian Lead & Zinc Co.	Ahangaran Mine	NA
Concentrate	Iran Zinc Mine Development Co.	Dandi Calcination plant, Zanjan	50
Do.	Calcimine Co.	Khoramshar plant	4 8/
Do.	Mineral Processing Co. of Iran	NA	NA
Metal	Bafgh Zinc Smelting Co.	Bafgh, Yazd	28
Do.	Angoran Zinc Melting Co. (Calcimine Co.)	Smelter at Angouran Mine, Zanjan	7
Do.	Qeshm Zinc Melting Co. (Calcimine Co.)	Qeshm Island	5

e/ Estimated. NA Not available.

1/ About 2,700 mines are in Iran, about 2,000 of which are active. About 65% of the active mines produce building and construction materials.

2/ Data were augmented by input from the Iranian National Committee of the World Mining Congress.

3/ Under construction.

4/ Refinery and electrowon output included 730-centimeter (cm) x 66-centimeter x 12.7-centimeter slabs (41,000 metric tons per year capacity), 730-centimeter x 25-centimeter billets (34,000 metric tons per year capacity), 8-millimeter wire rod (107,000 metric tons per year capacity), copper powder, or brass alloy.

5/ Gold is also recovered from Sar Chemesh copper plant slimes.

6/ In addition, a 600,000-metric-ton-per-year-capacity Zam Zam process direct reduction iron plant was under construction.

7/ Includes lead and zinc ores.

8/ Closed.

9/ Only includes nonassociated gas production.

10/ Approximately 500 dimension stone (decorative stone) quarries are in Iran.

THE MINERAL INDUSTRY OF

IRAQ

By Philip M. Mobbs

The mineral industry of Iraq was dominated by the production of hydrocarbons. The United Nations (U.N.) trade embargo (U.N. Security Council Resolution 661) imposed on Iraq after its 1990 invasion of Kuwait nominally restricted international trade with Iraq. Although official Iraqi crude oil exports had resumed in 1996 under U.N. Security Council Resolution 986 (known as the Oil for Humanitarian Aid Agreement or the oil-for-food program), other export routes were available for Iraqi crude oil and petroleum products (Corzine, 2000; Middle East Economic Digest, 2001). In 2000, the oil-for-food program was modified and renewed by resolutions 1293, 1302, and 1330.

The mineral industry was administered by the Ministry of Industry and Mineral Resources and the Ministry of Oil. Legislation that controlled mining included law 8 of 1997 and statutory instructions 1 of October 11, 1999, which included mining regulations. Petroleum legislation included law 229 of December 14, 1970, law 8 of 1997, and resolution 1400 of September 1, 1980. In September, the Government announced it would no longer accept dollars for exported oil, and by early November, Iraq's U.N.-monitored accounts were receiving payment for oil exports in euros (Sullivan and O'Connor, 2000; Arabia Online Ltd., October 9, 2000, Iraq central bank ditches dollars, accessed July 24, 2001, at URL http://www.arabia.com/iraq/business/article/english/0,5508,300686,00.html).

Aside from the hydrocarbon sector, mineral production was limited. Phosphate rock was mined at Akashat, and sulfur, at Mishraq. Salt was extracted from brine lakes and marine evaporation ponds. Clay, gypsum, limestone, sand and gravel, and stone were dug from a number of pits. Mineral-processing facilities included several cement plants, a direct-reduced iron plant at Khor al Zubair, nitrogenous fertilizer plants that produced ammonia and urea, a phosphate fertilizer complex at Al-Qaim, a steel plant at Khor al Zubair, and a sulfur-processing plant at Mishraq; sulfur was also recovered as a byproduct of oil and natural gas processing. Uranium was reportedly recovered in the past from the Akashat phosphate operation (Federation of American Scientists, October 9, 2000, Akashat/Ukashat, accessed June 20, 2001, at URL http://www.fas.org/nuke/guide/iraq/facility/akashat.htm).

Iraq produced crude oil from about 15 oilfields that included the Ain Zalah, the Bai Hassan, the Butmah, the Jambur, the Khabaz, the Kirkuk, the Saddam, and the Sufaiya in the north and the Bin Umr, the Luhais, the Missan, the West Qurna, the North Rumaila, the South Rumaila, and the Zubair in the south. Average crude oil production in 2000 was estimated to be between 2.6 and 2.8 million barrels per day (Mbbl/d) (Allen, 2000; U.S. Energy Information Administration, 2001b). Petroleum refining facilities included the 300,000-barrel-per-day (bbl/d) refinery at Baiji, which operated at about 140,000 bbl/d; the 170,000-bbl/d refinery at Basra, which operated at near capacity; and the 100,000-bbl/d refinery at Daura, which operated at about 70,000 bbl/d. These major refineries were operating with facilities and parts recovered from smaller prewar refineries. The Security Council's sanctions committee considered most oilfield modules and parts to be "dual-use"; that is, having the potential to be modified for military use. Consequently, contracts for such parts were often suspended by the sanctions committee (United Nations Security Council, 2000, Report of the group of United Nations experts established pursuant to paragraph 30 of the security council resolution 1284 (2000), accessed October 23, 2000, at URL http://www.un.org/Depts/oip/reports/oilexperts.htm). In 2000, Iraq was building six new refineries, which included a 10,000-bbl/d refinery at Baiji and a 10,000-bbl/d facility at Ammarah (Iran Daily, July 3, 2000, Economic features—Iraq plans six oil installations, accessed July 3, 2000, at URL http://www.iran-daily.com/daily.shtml).

During 2000, about 2.2 Mbbl/d of Iraqi crude oil was officially exported under U.N. supervision from the Ceyhan oil terminal in Turkey and the port of Mina al-Bakr, Iraq. In addition to official oil exports, Iraq also shipped about 90,000 bbl/d of crude oil and products to Jordan by truck under U.N. approval. Between 80,000 and 200,000 bbl/d of crude oil and petroleum products reportedly were smuggled out of Iraq by boat or truck to India, Iran, Pakistan, Turkey, and the United Arab Emirates (Middle East Economic Digest, 2001; Sipress, 2001). During 2000, Syria and Iraq rehabilitated the 738-kilometer (km) 700,000-bbl/d-capacity crude oil pipeline between Kirkuk, Iraq, and the port of Baniyas, Syria; the Syrian Government had closed the line in April 1982. Although Syria and Iraq claimed to be only testing the integrity of the aged pipeline, an estimated 100,000 to 150,000 bbl/d of Basra Light reportedly was moved through the line after pumping resumed in November (U.S. Embassy, Damascus, Syria, 2000; Sipress, 2001; Gulf News, November 22, 2000, Iraq confronts UN with oil sales to Syria, accessed May 14, 2001, at URL http://www.gulf-news.com/Articles/News.asp?ArticleID=3259; Gulf News November 23, 2000, Iraq tells UN it is getting Syria pipeline ready, accessed May 14, 2001, at URL http://www.gulf-news.com/Articles/News.asp?ArticleID=3303; Gulf News March 21, 2001, Oil briefs—U.S. says Syria confirms Iraq pipeline arrangement, accessed May 14, 2001, at URL http://www.gulf-news.com/Articles/News.asp?ArticleID=12570). In December, Iraq and Lebanon agreed to refurbish the 178-km pipeline that connected to the Iraq-Syria line at Homs, Syria, and ran to Tripoli, Lebanon (Arabia Online Ltd., December 9, 2000, Lebanon—Iraq agree to reopen oil pipeline, accessed on July 24, 2001, at URL http://www.arabia.com/iraq/business/article/english/0,5508,35–8,00.html).

In November, the Iraqi State Oil Marketing Organisation threatened to terminate oil loaders' access to future oil purchases unless the buyers paid a $0.50 per barrel premium into an Iraqi-controlled account in Jordan. The United Nations notified buyers that such a scheme, which would give Iraq an estimated $400 million per year outside U.N.-controlled funds, would be considered to be a flagrant violation of sanctions. After a 12-day cutoff of supplies at the beginning of December, Iraq reduced demands to a still illegal $0.30 per barrel premium on Kirkuk-grade crude oil pumped to Ceyhan and an illegal $0.40 surcharge on Basra Light-grade crude pumped to Mina al-

Bakr (Hoyos, Sullivan, and Durgin, 2000; Gulf News, November 16, 2000, Iraq asks crude lifters for 50 cent premium, accessed May 14, 2001, at URL http://www.gulf-news.com/Articles/News.asp?ArticleID=2772; Gulf News, December 21, 2000, Iraq revives demand for surcharge on crude exports, accessed May 14, 2001, at URL http://www.gulf-news.com/Articles/News.asp?ArticleID=5383).

In 2000, an average of 620,000 bbl/d of exported Iraqi crude oil reached the United States. This accounted for about 6% of net U.S. crude oil imports and was a drop from 1999 average daily imports, thus reversing the increasing trend of U.S. imports from Iraq. An average of 725,000 bbl/d was imported from Iraq in 1999, 336,000 bbl/d in 1998, 89,000 bbl/d in 1997, and 1,000 bbl/d in 1996 (U.S. Energy Information Administration, 2001a). Iraq was the United States' sixth largest crude oil supplier after Saudi Arabia, Canada, Mexico, Venezuela, and Nigeria (U.S. Energy Information Administration, 2001c).

After a 19-year hiatus, rail service resumed between Iraq and Syria in August. Negotiations were being held with Iran and Turkey for additional freight and passenger rail service.

In 1995, the Ministry of Oil estimated total proven crude oil reserves to be 112 billion barrels and natural gas reserves to be 3.1 trillion cubic meters (Arab Petroleum Research Center, 1999, p. 160, 173). Nearly 60 evaluated petroleum prospects were undeveloped, and there were substantial unexplored areas in Iraq. A number of international oil companies had entered into buy-back (post-1999) or production-sharing (pre-2000) contracts that would become active once sanctions were lifted. The Government projected that it would take 6 to 8 years after the U.N. embargo is lifted to reach a target production capacity of 6 Mbbl/d (Oil & Gas Journal, 2000). Actual production could be subject to quotas allocated by the Organization of the Petroleum Exporting Countries, given the impact that increased production tended to have on oil prices received by other members of the cartel. Any significant increase in production would required new export pipelines, gas-processing plants, and storage facilities (Richards, 2001). Significant increases in oil and natural gas production capacity also would raise interest in adding new metal-processing facilities, oil refineries, petrochemical plants, and power stations in Iraq.

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TABLE 1
IRAQ: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000
METALS						
Steel, crude		300	200	200	200	200
INDUSTRIAL MINERALS						
Cement, hydraulic		1,600	1,700	2,000	2,000	2,000
Nitrogen, N content of ammonia		220 r/	220 r/	220 r/	220 r/	220
Phosphate rock, beneficiated, phosphorus pentoxide content		300	300	300	300	300
Salt		250	250	250	300	300
Sulfur, elemental:						
Native, Frasch		250	250	250	250	225
Byproduct 4/		50	50	50	50	25
Total		300	300	300	300	250
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross	million cubic meters	3,480 5/	3,800	6,000	7,000	7,500
Dry	do.	3,240 5/	3,000	3,000	2,800	3,000
Natural gas plant liquids	thousand 42-gallon barrels	10,000	10,000	8,000	3,000	4,000
Petroleum:						
Crude (including lease condensate)	do.	213,000 5/	433,000 5/	750,000 5/	915,000 5/	930,000
Refinery products	do.	170,000	175,000	180,000	125,000	140,000

r/ Revised.

1/ Includes data available through July 23, 2001.

2/ Data are rounded to no more than three significant digits.

3/ In addition to commodities listed, the following also were probably produced, but information is inadequate to estimate output: clay, fluorine compounds, gypsum, lime, limestone, industrial (glass) sand and gravel, stone, and uranium.

4/ Presumably from petroleum and natural gas processing.

5/ Reported figure.

THE MINERAL INDUSTRY OF

ISRAEL

By Thomas R. Yager

Israel was a producer of such metals and metal products as lead, magnesium, and steel, and such industrial minerals as bromine, bromine derivatives, flint clay, gypsum, kaolin, lime, magnesia, phosphate rock, potash, silica sand, and sulfur. Building materials produced in Israel included cement, crushed stone, marble, and sand. The country also cuts imported diamond and produced caustic soda, fertilizers, natural gas, petroleum and petroleum products, phosphoric acid, and sulfuric acid.

The Bank of Israel estimated that the country's gross domestic product (GDP) grew by 5.9% in 2000, compared with 2.4% in 1998 and 2.3% in 1999 (Central Bank of Israel, 2001, p. 3). The construction sector started to recover in the second half of 2000 after declining from 1998 through the first half of 2000. In 2000, the constant dollar value of nonmetallic mineral products and production in the Israeli mining and quarrying industry fell by 8.3% and 2.3%, respectively, and chemicals and refined petroleum and basic metal rose by 3.4% and 1.9%, respectively. Chemicals and refined petroleum accounted for 9.89% of industrial production; nonmetallic minerals, 3.74%; mining and quarrying, 2.74%; and basic metal, 2.08% (Israel Central Bureau of Statistics, April 2001, Manufacturing production indices, by division—New classification, Monthly bulletin of statistics, accessed May 24, 2001, at URL http://www.cbs.gov.il/archive/200104/yarhon/m2_e.htm).

In 1999, the U.S. Central Intelligence Agency (2000) estimated that Israel's GDP amounted to about $105 billion at purchasing power parity. The per capita income at purchasing power parity was $18,300 in 1999.

In 2000, Israel's exports amounted to nearly $28.3 billion. The value of exported diamond was $6.8 billion, of which $5.4 billion was polished and $1.4 billion was rough; this was an increase from $5.7 billion in 1999 (International Monetary Fund, 2001, p. 55). In 2000, Israel exported about 1.76 million metric tons (Mt) of cement, 1.48 Mt of potash, and 1.13 Mt of phosphate rock. Other energy, metal, and mineral products exported in recent years included aluminum, bentonite, kaolin, lead, magnesia, petroleum, salt, silver, titanium, and tungsten, as well as secondary scrap of aluminum, copper, lead, nickel, and steel. Basic metal, mining and quarrying, and nonmetallic mineral products accounted for about 2.6% of exports in 1999 (Israel Central Bureau of Statistics, 2000, p. 8.16).

In 2000, Israel's imports amounted to $35.2 billion, of which nearly $6.4 billion were diamonds. This was an increase from nearly $5.7 billion in 1999. Imports of fuels rose to $3.5 billion in 2000 from $2.1 billion in 1999 (International Monetary Fund, 2001, p. 58); this increase was primarily attributable to higher world oil prices. In 1999, Israel imported nearly 9.6 Mt of coal, 575,500 metric tons (t) of sulfur, 459,000 t of clinker, and 110,000 t of cement. Other metal and industrial mineral imports in recent years included aluminum, asbestos, diatomite, feldspar, gypsum, kaolin, lead, magnesite and magnesia, manganese ore, mercury, phosphate rock, silver, steel, talc, tin and tin alloys, tungsten, and zinc and zinc alloys.

Commodity Review

Metals

Lead.—In November, Harkunas Lead Works, which was Israel's secondary lead smelter and battery reprocessor, indicated that its $1.9 million expansion project would be completed in December. Plant capacity would nearly double to 25,000 metric tons per year (t/yr) of lead; production at full capacity was expected to start in January 2001. The project was driven by rising battery consumption, which caused increased demand for lead from Israeli battery producers (Metal Bulletin, 2000b). Harkunas sourced most of its material from Eastern Europe. Most of the plant's exports were shipped to Greece, Italy, and Spain (Metal Bulletin, 2000a).

Magnesium.—An estimated 23,000 Mt of magnesium chloride is dissolved in the waters of the Dead Sea (Jordan Natural Resources Authority, 1989, p. 104). Dead Sea Magnesium, Ltd. (DSM) [joint venture between Israel Chemicals Limited (ICL) (65%) and Volkswagen AG of Germany (35%)], started production of magnesium metal in 1997, and expected to reach 34,000 t/yr capacity by the end of 2000. The plant's raw material was carnallite, which is dehydrated, melted, and electrolyzed to yield magnesium metal and chlorine. The residual salt and potash were sent to the potash plant for refining (Dead Sea Works, Ltd., 2001, Industrial activity at the Dead Sea, accessed May 22, 2001, at URL http://www.dsw.co.il/history5.htm).

The brines that DSW sold to its sister company Dead Sea Periclase Ltd. (DSP) were used in the production of magnesia. DSP produced 95,000 t/yr of magnesia, of which about 65,000 t/yr was dead burned magnesia. About 10,000 to 15,000 t/yr of dead burned magnesia was fused in-house at Taheto Dead Sea Fused Magnesia Co., which was a joint venture company. DSP produced magnesia with a minimum magnesia content of 99.0% and very little boron, iron, or silica; the company's product tended not to compete with Chinese magnesia. Some refractory manufacturers mix DSP's magnesia with Chinese magnesia to achieve the right balance between composition and price (Pearson, 2000, p. 47-49).

DSP is focusing increasingly upon specialty magnesia markets, including flame retardants, food additives, pharmaceuticals, and polymer additives. Other DSP products include caustic calcinated magnesia, magnesium chloride, and magnesium hydroxide (Pearson, 2000, p. 47-49).

Magnesium from the Dead Sea was also used to produce magnesium chloride flakes. DSW operated the world's largest magnesium chloride flakes plant for such applications as abrasives, deicing, dust suppression, fertilizers, and oil drilling.

Industrial Minerals

Bromine.—The Dead Sea has substantial resources of bromine; an estimated 975 Mt of magnesium bromide is dissolved in its waters (Jordan Natural Resources Authority, 1989, p. 104). Brines and carnallite ores from the Dead Sea were used as raw material for Israel's production of bromine and bromine derivatives. Dead Sea Bromine Group (DSBG) (a subsidiary of ICL) accounted for 35% of world bromine production (Lyday, 2001). DSBG produced bromine derivatives with applications in air conditioning, batteries, cleaning solvents, flame retardants, mineral separation, oil drilling, photography, and water treatment; more than 90% of the company's sales was from exports.

In the first half of 2000, DSBG's sales grew by about 18% owing to rising sales and increased demand for calcium bromide from the oil-drilling industry and flame-retardant products from the personal computer, electronics, and telecommunication industries. DSBG's profits in 2000 were affected by the plea agreement that the company reached with the U.S. Department of Justice concerning an investigation pertaining to allegations of violations of the trade restriction laws in the United States. According to the agreement, DSBG will pay $7 million to the U.S. Government (Dead Sea Bromine Group, September 27, 2000, DSBG sales grew by 18% in the first half of 2000, accessed May 22, 2001, at URL http://www.deadseabromine.com/brome/files.nsf/lookup/FlashNews.htm?OpenDocument). In 2000, ICL increased its share of DSBG to 100% from 89.1%.

Cement.—After declining in 1999 to about 6.35 Mt, Israel's production of cement increased to 6.6 Mt in 2000. Domestic consumption increased to 5.1 Mt from 4.85 Mt. Residential uses amounted to 55% of the domestic demand for cement, and infrastructural, defense, and other users accounted for 17%, 8%, and 19%, respectively. The country's sole producer Nesher Israel Cement Enterprises Ltd. operated the Haifa, Har- Tuv, and Ramla plants. These plants had a total capacity of 8 million metric tons per year. The company greatly reduced particle emissions by closing down three of its old wet kilns and starting up two new dry-process kilns in their place (International Cement Review, 2001, p. 172).

Israel's imports of cement were estimated to be 250,000 t in 2000, which was more than double the 1999 figure of 110,000 t. All imported cement originated from Turkey, and clinker was imported from Croatia, Cyprus, Greece, and Turkey. Exports increased to 1.76 Mt in 2000 from 1.6 Mt in 1999. The majority of exports were shipped to areas in the West Bank under the control of the Palestinian Authority (International Cement Review, 2001, p. 172).

Diamond.—In spite of the recent increase in exports, the Israeli diamond industry was undergoing substantial consolidation. In 1998, 40% to 50% of diamond exports were to the United States. By 2000, this figure had increased to between 65% to 70%. The U.S. market, which was highly competitive, had long credit terms and low profitability owing to higher prices for rough diamond that have not been matched by polished prices. Small to medium manufacturers were most vulnerable to these conditions. Conflict diamond posed another potential difficulty for the industry (Solomon, 2001).

Flint Clay.—Deposits of flint clay occur in the Negev Desert; the alumina content of these clays ranges from 35% to 55%. Negev Industrial Minerals Ltd. (NIM) (a wholly owned subsidiary of ICL) produced flint clay and kaolin at its Mactesh Ramon plant. Most sales of NIM's clays were to the European ceramics and refractory industries or the Israeli chemical, ceramics, and fertilizer industries, which included other ICL companies (Harben and Minster, 1997, p. 61).

Limestone.—Israel has several deposits of limestone that are exploited on a commercial basis. M.P. Minerals and Marble Ltd. mined limestone from Mount Nitzim in the Negev Desert. The limestone was used in the animal feed, chemical, construction, fertilizer, glass, and pharmaceutical industries; other uses include fillers in the adhesives, plastics, paint, and rubber industries. K.G. Powders also mined limestone from the Galilee Mountains for use as a filler. Yehu Clays Ltd. produced calcium carbonate from limestone quarries in the Aroer and Yeroham areas. NIM operated a lime and limestone plant at Mishor Rotem, which produced lime used in aerated blocks (Ytong), paper, and other industries.

Phosphate.—Substantial resources of phosphate rock occur in the northern Negev region. Arad-Rotem, which was the largest deposit, has 300 Mt, and the Zohar, Zin, and Arava deposits have 250 Mt, 150 Mt, and 150 Mt, respectively. Israel's phosphate rock resources were exploited by Rotem Amfert Negev Ltd. (a wholly owned subsidiary of ICL) (Harben and Minster, 1997, p. 59).

In 1999, Rotem produced about 4.13 Mt of phosphate rock, 600,000 t of phosphoric acid (P_2O_5 equivalent), and about 1.6 Mt of fertilizers. The company also produced speciality chemicals and phosphorous salts (Israel Chemicals Ltd., 2000, Israel Chemicals Ltd.—Group companies, accessed May 22, 2001, at URL http://www.israelchemicals.co.il/icl/icl.nsf/frmFrameSet?readform&FrameMenu=group&ItemType=document). The company's main export markets for phosphoric acid were India, Italy, and Turkey, and the main export markets for phosphate rock were Brazil (about 42%), France, Ireland, Italy, the Netherlands, Spain, and the United Kingdom. In 2000, production of phosphate rock fell to about 4.11 Mt from 4.13 Mt, and exports of phosphate rock fell to 1.13 Mt from 1.23 Mt (Fertilizer Markets, 2001).

Potash.—The Dead Sea has enormous resources of potassium; an estimated 7,260 Mt of potassium, which included 2,050 Mt of potassium chloride (KCl) is dissolved in seawater (Abu-Ajamieh, 1989, p. 61). Carnallite that contains potassium from the Dead Sea is used as raw material for Israel's potash plants. DSW was the world's fourth largest producer of potash, and its Israeli plants accounted for about 7% of world production. The company's production of potash increased modestly in 2000, and exports rose to 1.48 Mt from 1.34 Mt. About 87% of DSW's production was exported in 2000; Brazil accounted for 26% of DSW's exports, and India and China accounted for 19% and 13%, respectively (Fertilizer Markets, 2001).

DSW completed a 3-year expansion program to increase its potash capacity by 300,000 t/yr at the end of 2000. The expansion included the installation of two Sahut Conreur compactors (Fertilizer Markets, 2001). With DSW's new program to increase potash production capacity by an additional 450,000 t/yr, the total increase in capacity will be 750,000 t/yr.

Salt.—Israel's resources of salt (NaCl) are very substantial; an estimated 12,650 Mt of NaCl is dissolved in the waters of the Dead Sea (Jordan Natural Resources Authority, 1989, p. 132, 134). DSW was the largest producer of salt in Israel. The company obtained salt separated from carnallite during the potash production process, which is used in local electrolysis, in deicing and fish pickling in Europe, and as table salt in Israel and abroad. DSW's production amounted to about 500,000 t/yr (Harben and Minister, 1997, p. 52). Israel Salt Industries Ltd. was another domestic producer.

Silica Sand.—At the Hatira plant, NIM mined and screened high-purity silica sand, which was used in the ceramics, construction, die casting, and flat and container glass industries (Harben and Minster, 1997, p. 61). NIM's silica sand is used by Phoenicia America-Israel (Flat Glass) Ltd., which was Israel's sole producer of float and pattern glass. Phoenicia's Zipporit plant produced 150,000 t of float, pattern, and other types of glass in 2000. Sales in 2000 amounted to $72 million, of which $42 million was exported to Australia, Cyprus, Egypt, Greece, Italy, Jordan, Latin America, South Africa, and the United Kingdom (Dun & Bradstreet, 2000, Phoenicia America-Israel (Flat Glass) Ltd. profile, accessed August 23, 2001, at URL http://duns100.dundb.co.il/1487).

Mineral Fuels

Coal.—Most Israeli energy demand were met through imports. All Israel's coal supplies (about 9.6 Mt in 1999) were imported; about half was sourced from South Africa, and the rest, in order of importance, from Colombia, the United States, Australia, Indonesia, and Poland. In March 2000, officials of the National Coal Supply Corporation announced plans to increase imports of coal from Australia. Growth in coal imports was being driven mainly by rapid growth in electricity demand. With the expansion of Israel's fourth coal-fired power plant, the country's coal imports could rise by 15% by 2002 (U.S. Energy Information Administration, October 25, 2000, Israel—Coal, Country analysis brief, accessed May 24, 2001, at URL http://www.eia.doe.gov/cabs/israel.html).

Natural Gas.—In 2000, two major discoveries of gas were made at Gaza Marine, and Mari B. Israel hosted a substantial increase in drilling compared with that of 1999 and offered 18 new licenses (Cross, 2001). Israel's petroleum authority estimated that Israel has 85 billion to 142 billion cubic meters in natural gas reserves, which may be enough to supply Israeli demand for years (U.S. Energy Information Administration, October 25, 2000, Israel—Natural gas, Country analysis brief, accessed May 24, 2001, at URL http://www.eia.doe.gov/cabs/israel.html).

Petroleum.—The Petroleum Commission estimated Israel's oil reserves to be 5 billion barrels, most of which was associated with natural gas. Israel produced less than 0.1% of its oil demand; major import sources included Egypt, Mexico, the North Sea, and West Africa. Israel's geographic location between the Arabian Peninsula and the Mediterranean Sea could make the country an alternative route for Persian Gulf oil to the West. This restructuring of oil flows is unlikely to occur in the near future; a comprehensive settlement of the Arab-Israeli conflict would be necessary (U.S. Energy Information Administration, October 25, 2000, Israel—Oil, Country analysis brief, accessed May 24, 2001, at URL http://www.eia.doe.gov/cabs/israel.html).

Infrastructure

In 1999, Israel produced 39,180 gigawatthours (GWh) of electricity. After its own use in production and losses in distribution, 34,300 GWh was available for consumption. About 26% of available power was consumed by the manufacturing sector. Production of electricity has increased by 29% since 1995 (Israel Central Bureau of Statistics, 2000, p. 15.1, 15.3).

According to Israel's national utility the Israel Electric Corporation (IEC), installed electric generating capacity amounted to 8.6 gigawatts (GW) in 1999. Coal-fired plants accounted for 70% of capacity; fuel-oil-fired plants, 25%; and gasoil and independent power producers (IPPs), 5%. Israel made substantial use of solar energy to heat water. Because Israel's power demand is increasing rapidly, the IEC estimated that it will be necessary to increase capacity to more than 10 GW by 2002 and 14.3 GW by 2010 (U.S. Energy Information Administration, October 25, 2000, Israel—Electricity, Country analysis brief, accessed May 24, 2001, at URL http://www.eia.doe.gov/cabs/israel.html).

To meet increasing demand, the IEC planned to raise $1.2 billion to $1.3 billion per year in new financing for generation, transmission, and distribution systems. The IEC was converting some of its oil- and diesel-fired generators to gas generators, and planned to have 25% of its power generated by gas within the next 5 years. On June 29, 2000, a new coal plant at the Mediterranean Sea port of Ashkelon was inaugurated. This facility, which has a capacity of 1.1 GW, was the first power plant in Israel to have sophisticated antipollution scrubbers. IEC planned to spend about $1 billion during the next 10 years to help reduce emissions from its power plants (U.S. Energy Information Administration, October 25, 2000, Israel—Electricity, Country analysis brief, accessed May 24, 2001, at URL http://www.eia.doe.gov/cabs/israel.html).

The IEC's plan for greater reliance on natural gas would increase diversity in energy sources, benefit the environment, and reduce the IEC's electric generation costs. As of mid-2000, the IEC reportedly was studying proposals from BG Group, East Mediterranean Gas Company, Sdot Yam, and Yam Thetis to supply 7 million cubic meters per day to its powerplants. Israel was exploring the possibility of other domestic energy sources, such as oil shale from Nahal Zin and solar power (U.S. Energy Information Administration, October 25, 2000, Israel—Electricity, Country analysis brief, accessed May 24, 2001, at URL http://www.eia.doe.gov/cabs/israel.html). Israel's known exploitable potential hydroelectric energy is 1.6 GW (World Resources Institute and others, 1996, p. 289).

Other developments in the power sector included privatization and regional cooperation. The Ministry of Energy directed the IEC to purchase at least 900 megawatts (MW) of power from IPPs by 2005. About 150 MW was expected to come from solar and wind facilities, and the rest, mainly from natural-gas-fueled facilities; the goal was for 10% of electricity to be produced by IPPs. Israel and Jordan have discussed the possibility of linking their power grids and jointly building several power stations. The proposed stations included a 1,000-MW-capacity plant on the Israeli-Jordanian border, an 800-MW-capacity plant in Jordan, a 150-MW-capacity solar thermal plant near Eilat, and a 100-MW-capacity wind farm. The IEC also explored the possibility of cooperating in the development of wind power with Syria. These plans would depend on a successful Israeli-Syrian peace treaty. The IEC has estimated that as much as 10% of Israel's power supplies could be imported in the future (U.S. Energy Information Administration, October 25, 2000, Israel—Electricity, Country analysis brief, accessed May 24, 2001, at URL http://www.eia.doe.gov/cabs/israel.html).

Israel's transportation network comprised nearly 16,000 kilometers (km) of paved highways and 610 km of railroads. There were 708 km of pipelines for crude oil, 290 km for petroleum products, and 89 km for natural gas. Ports and harbors were Ashdod, Ashkelon, Eilat, Hadera, Haifa, and Tel Aviv-Yafo (U.S. Central Intelligence Agency, 2000).

Outlook

The outlook for Israel's bromine, lead, magnesia, phosphate, potash, and salt industries depends heavily upon world market conditions for these commodities; the cement, crushed stone, gypsum, lime, marble, and natural gas industries are more dependent upon the strength of the Israeli economy. Unrest owing to the collapse of the peace process could have substantial effects upon the economy in 2001.

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TABLE 1
ISRAEL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1996	1997	1998	1999 e/	2000 e/
METALS					
Iron and steel, steel, crude e/	246,000 r/	268,000 r/	244,000 r/	280,000 r/	285,000
Lead, refined	12,000	12,000	12,000	13,000	13,200
Magnesium metal	100 e/	7,000 r/	25,000	28,000 3/	34,000
INDUSTRIAL MINERALS					
Bromine:					
Elemental	154,000 r/	180,000 3/	185,200 r/ 3/	185,000	200,000
Compounds e/	143,000 r/	167,000 r/	172,000 r/	172,000 r/	186,000
Caustic soda e/	41,000 r/ 3/	41,700 r/	41,700 r/	41,200 r/	42,600
Cement, hydraulic thousand tons	5,600 r/	5,400	6,476 r/	6,354 r/ 3/	6,600
Clays:					
Flint clays	50,000 r/	45,000 r/	23,000 r/	23,200 r/	22,700
Kaolin	14,000 r/	16,000 r/	27,000 r/	27,300 r/	26,700
Other e/	8,500	8,500	8,500	8,500	8,500
Diamonds 4/ thousand carats	2,522	2,373	1,795	1,833 3/	1,900
Gypsum	161,000 r/	120,875 r/	56,000 r/	50,000 3/	45,800
Lime e/	275,000	344,000 r/ 3/	378,000 r/ 3/	336,000	308,000
Magnesia, Mg content e/	42,200	53,300 r/	57,000 r/	57,000 r/ 3/	57,000 3/
Nitrogen, N content of ammonia and urea	64,600 e/	56,600	500	-- 3/	-- 3/
Phosphate:					
Phosphate rock:					
Beneficiated thousand tons	3,839	4,047	4,067 r/ 3/	4,128 r/ 3/	4,110 3/
P_2O_5 content do.	1,201 r/	1,260	1,288 r/	1,310 r/	1,300
Phosphatic fertilizers do.	1,300	1,800	1,700 e/	1,600	1,590
Phosphoric acid, P_2O_5 equivalent e/	390,000	630,000	650,000	600,000	590,000
Potash, K_2O equivalent do.	1,500	1,488	1,668	1,702	1,710
Salt, marketed (mainly marine) do.	765 r/	750 r/	874 r/	883 r/	863
Sand: e/					
Silica sand	284,000 r/	275,000 r/ 3/	257,000 r/ 3/	249,000 r/	243,000
Other e/ thousand tons	11,400 r/	11,000 r/ 3/	9,000 r/ 3/	8,730 r/	8,530
Sodium and potassium compounds, caustic soda e/	29,900 r/	30,400 r/	30,400 r/	30,000 r/	31,100
Stone: e/					
Crushed thousand tons	36,200 r/	35,000 r/ 3/	33,000 r/ 3/	32,000 r/	31,200
Dimension, marble do.	12,000	12,000	12,000	12,000	12,000
Sulfur:					
Byproduct from petroleum do.	24 r/	30 r/	32 r/	31	31
Sulfuric acid e/ do.	135 r/	137 r/	137 r/	135 r/	140
MINERAL FUELS AND RELATED MATERIALS					
Gas, natural: e/					
Gross thousand cubic meters	13,500 r/	14,200 r/	11,400 r/	10,000 r/	9,300
Dry do.	13,500 r/	14,200 r/	11,400 r/	10,000 r/	9,300
Petroleum:					
Oil shales	420,800	471,800	443,900	449,400	465,000
Crude 42-gallon barrels	32,296 r/	33,764 r/	38,902 r/	31,562 r/ 3/	31,600
Refinery products:					
Liquified petroleum gas do.	3,222 r/	3,566 r/	3,509 r/	3,482 r/ 3/	3,600
Gasoline do.	17,309 r/	17,107 r/	17,080 r/	18,812 r/ 3/	19,400
Naptha do.	5,997 r/	6,369 r/	7,287 r/	7,086 r/ 3/	7,320
Kerosene do.	7,977 r/	7,734 r/	8,189 r/	8,702 r/ 3/	8,990
Distillate fuel oil do.	13,932 r/	14,308 r/	15,573 r/	16,683 r/ 3/	17,200
Residual fuel oil do.	10,525 r/	9,688 r/	9,584 r/	9,469 r/ 3/	9,790
Other e/ do.	3,960 r/	4,320 r/	5,270 r/	5,130 r/	5,300
Total do.	62,922 r/	63,092 r/	66,492 r/	69,364 r/	71,600

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through June 26, 2001.

2/ In addition to the commodities listed, a variety of other crude construction materials are produced, but available information is inadequate to make estimates of output.

3/ Reported figure.

4/ Imported diamonds cut in Israel.

THE MINERAL INDUSTRIES OF

JORDAN, LEBANON, AND SYRIA

By Thomas R. Yager

JORDAN

In recent years, Jordan has been a major producer and exporter of potash and phosphate. It has also produced such industrial minerals as feldspar, gypsum, kaolin, lime, and salt and such building materials as cement, dimension stone, limestone, and marble. Natural gas and petroleum products have been produced for domestic consumption. Deposits of copper, gold, iron, and titanium also occur in Jordan.

In 1999, Jordan's gross domestic product (GDP) amounted to about $16 billion at purchasing power parity, and per capita income at purchasing power parity was $3,500 in 1999 (U.S. Central Intelligence Agency, 2000a). In the same year, the output of the mining and quarrying sector amounted to 3.1% of GDP; construction, 4.6%; and electricity and water, 2.6% (Jordan Central Bank, May 2001, Sectoral relative importance of gross domestic product at 1994 prices, accessed June 28, 2001, at URL http://www.cbj.gov.jo/docs/bulletin/36.xls).

In 2000, total exports were valued at $1.5 billion. Exports of potash amounted to $195 million; phosphate rock, $128.2 million; phosphoric acid, $104 million; fertilizers, $84.4 million; cement, $23.1 million; building stone, $5.1 million; and sulfuric acid, $2.9 million[1] (Jordan Central Bank, May 2001, External sector—Domestic exports by commodity, accessed June 28, 2001, at URL http://www.cbj.gov.jo/docs/bulletin/36.xls). Jordan's exports of phosphate rock rose to nearly 6 million metric tons (Mt) in 1998 from 3.9 Mt in 1998. The country's exports of potash fell to 1.7 Mt in 1999 from 1.8 Mt in 1995. Jordanian salt exports grew to 144,749 metric tons (t) in 1998 from 1,475 t in 1995 (British Geological Survey, p. 209, 218, 232). Cement exports amounted to about 800,000 t in 1999 (International Cement Review, 2001a). Other exports included alumina hydrate, kaolin, and sulfur as well as secondary scrap of aluminum, copper, lead, steel, tin, and zinc.

In 2000, total imports were valued at $4.5 billion. Imports of crude petroleum amounted to $526.9 million; refined petroleum products, $144.4 million; iron and steel products, $138.5 million; crude minerals and crude fertilizers, $36.5 million; and ammonia, $24.3 million (Jordan Central Bank, March 2001, External sector—Imports by commodity, accessed April 30, 2001, at URL http://www.cbj.gov.jo/docs/bulletin/37.xls). Other imports included alumina, aluminum and aluminum alloys, feldspar, fluorspar, gold, gypsum, industrial diamond, kaolin, lead, silver, sulfur, talc, titanium oxides, and zinc.

Commodity Review

Metals

Magnesium.—An estimated 23,000 Mt of magnesium chloride is dissolved in the waters of the Dead Sea (Jordan Natural Resources Authority, 1989, p. 104). Arab Potash Company (APC) was exploring the possibility of using carnallite or brines from the Dead Sea to produce magnesium metal (Arab Potash Company, 2000).

APC was engaged in a feasibility study for a magnesium chloride flakes plant with a capacity of 100,000 to 300,000 t/yr. The plant's product would be used mainly for deicing, dust control, and other industrial applications (Al Ali, 2000).

Jordan Magnesia Company (a subsdiary of APC that was established in 1997) was building a plant to produce magnesia; magnesium will be extracted from the Dead Sea's plentiful resources of magnesium chloride. The plant will produce about 50,000 metric tons per year (t/yr) of refractory-grade magnesia and 10,000 t/yr of other grades of magnesia for chemical, environmental, fertilizer, and plastic applications. The fused magnesia will have a grade of at least 97.5% MgO. Production was expected to start in mid-2001 (Jordan Magnesia Co., 2000, Profile, accessed April 27, 2001, at URL http://www.jormag.com/profile.htm).

Manganese.—Several deposits of manganese ore occur in the Feinan area (Wadi Dana, Khirbet en Nahas, Salawan, Wadi Mahjoub, and Wadi Dabba'a). Only Wadi Dana has been studied in detail; this deposit has estimated resources of 1.5 Mt of ore at a grade of 38% manganese and 1.5% copper. A rough estimate of the possible resources in the Feinan area was about 5 Mt of ore at a grade of 35% to 45% manganese and 1.0% to 1.5% copper (Abu-Ajamieh, 1989, p. 101).

Industrial Minerals

Bromine.—An estimated 975 Mt of magnesium bromide is dissolved in the waters of the Dead Sea (Jordan Natural Resources Authority, 1989, p. 104). Jordan Bromine Co. Ltd. (a joint venture of APC, Jordan Dead Seas Industry Co. Ltd., and the U.S.-based Albemarle Holding Co. Ltd.) was building a plant to produce bromine and bromine compounds and was expected to start production by 2004. The plant will have a production capacity of 50,000 t/yr of elemental bromine, 49,000 t/yr of caustic potash, 35,000 t/yr of tetrabromobisphenot, 30,000 t/yr of calcium bromide, and 30,000 t/yr of chlorine (Arab Potash Company, 2000, JODICO, accessed April 25, 2001, at URL http://www.arabpotash.com/arabpotash/jodico.html).

Feldspar.—Extensive resources of feldspar are found at Wadi Hawd Es Sufun, Jebel Aboul Ghoufran, and Wadi Mahlaba. Research conducted by the Jordan Natural Resources Authority has revealed that the process of separating feldspar to its main components and reducing the iron content would not be cost effective. In 2000, feldspar was consumed without beneficiation except grinding by the Jordanian ceramic industry (Al Ali, 2000).

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[1] Where necessary, values have been converted from Jordanian dinar (JOD) to U.S. dollars at the rate of JOD0.714=US$1.00.

Gypsum.—Jordan has several deposits of gypsum that were being commercially exploited. Reserves were estimated to be 10 Mt at Wadi Zarqa, 8 Mt in the area between Wadi Mujib and Tafila, and 3 Mt at Azraq; reserves in the Lisan area have not been determined. The Wadi Zarqa gypsum is low grade but suitable for use in cement manufacturing. The deposits in southern Jordan were higher grade and were used at the cement factory at Al-Rashadiya and by many local miners to produce a variety of products, such as plaster and gypsum board (Al Ali, 2000).

Kaolin.—Most of Jordan's kaolin occurs in the southeastern part of the country. Reserves were estimated to be 9.7 billion metric tons (Gt) at Al-Mudawwara, 400 Mt at Batn-El Ghoul, 20 Mt total at Fujij and Rashadiya, and 5 Mt at Ghor Kabid and Mahis. The reserves at Al-Hiswa have not been determined (Jordan Natural Resources Authority, 2000, Nonmetallic minerals—Clay, accessed April 25, 2001, at URL http://www.nra.gov.jo/side.htm). At Al-Mudawwara and Batn El-Ghoul, the average Al_2O_3 content of the kaolin ranges between 14% and 25%, and the average Fe_2O_3 content ranges between 6% and 9%. Kaolin was produced by the Public Mining Company for use in the local ceramics industry (Al Ali, 2000).

Limestone.—Notable deposits of limestone occur at several locations. Reserves were estimated to be 50 Mt in the area between Qatrana and Siwaqa and 10 Mt at El Lubban. Resources at El-Hallabat, which is 60 kilometers (km) northeast of Amman, and Al Fuheis, which is near a major cement plant, have not been determined. Jordan's limestone was used in aggregates, building stone, floor tiles, powder in fertilizer and pharmaceuticals, and raw material for white cement (Al Ali, 2000). Jordan Magnesia's plant will also require about 165,000 t/yr of limestone as raw material. The limestone will be mined from Qatrana starting in 2001 (Jordan Magnesia Company, 2000, Raw materials, accessed April 27, 2001, at URL http://www.jormag.com/raw.htm).

Phosphate.—Jordan has substantial reserves of phosphate rock, which were exploited by the Jordan Phosphate Mines Company (JPMC) at four mines. The Shidiya Mine has proven reserves of 1.2 Gt and possible reserves of 4.0 to 5.0 Gt; al-Hasa and al-Abiad Mines, 200 to 300 Mt of proven reserves; and the Ruseifa Mine, 70 Mt. Production at the Shidiya Mine was running at 3.3 million metric tons per year (Mt/yr) in 1999; JPMC planned to boost the output to 7.5 Mt/yr by 2001 and to 10 Mt/yr by 2003. About 85% of phosphate rock production was exported, and the rest was used in the domestic manufacture of fertilizers (Arab Petroleum Research Center, 2000a).

In 1998, APC and Kemira Agro OY formed a joint venture to produce 150,000 t/yr of potassium nitrate fertilizer and 75,000 t/yr of dicalcium phosphate animal feed supplement. These products will be marketed worldwide and were expected to generate $60 million per year. Production was expected to start in 2002. This plant will absorb most of the increase in APC's potash capacity (Industrial Minerals, 2000).

Potash.—The Dead Sea has enormous resources of potassium; an estimated 7.3 Gt of potassium, which includes 2.1 Gt of potassium chloride is dissolved in its waters (Abu-Ajamieh, 1989, p. 61). Potassium from the Dead Sea was used as raw material for Jordan's potash plants. The APC was one of the world's largest producers of fertilizer-grade potassium chloride with a capacity of 2.0 Mt/yr. The company planned to increase capacity to 2.4 Mt/yr of potash by the year 2006. The capacity of the plants and the solar evaporation ponds expansion will be increased (Industrial Minerals, 2000). APC sold its products in 30 countries, mainly to markets in India, China, and Indonesia; these countries were expected to account for more than 60% of APC's exports (Al Ali, 2000).

Salt.—Jordan's resources of salt are located in the Azraq depression, the Dead Sea, and below El Lisan peninsula in the Dead Sea. An estimated 12.7 Gt of salt is dissolved in the Dead Sea's waters (Jordan Natural Resources Authority, 1989, p. 132, 134). The salt deposit in the Azraq depression was exploited by Al Azraq, and the Dead Sea salt was exploited by the Jordan Safi Salt Company (JOSSCO) (36% owned by APC).

JOSSCO's plant, which started production in 1996, had a capacity of 1.2 Mt/yr of industrial salt and 32,000 t/yr of table salt (Al Ali, 2000). The local market absorbed only 11% of JOSSCO's production; in 1999, the company exported more than 350,000 t of industrial salt to 12 markets. Saudi Arabia and Iraq accounted for 16% and 14%, respectively, of JOSSCO's industrial salt exports. In 1999, the Qatari Salt Processing and Production Company purchased 40% of JOSSCO and signed a 5-year contract to purchase 250,000 t/yr of Jordanian salt. The 5-year purchase contract took effect in the last quarter of 2000 (Jordan Times, February 3, 2000, Bid by Qatari investors could shake up salt company, accessed April 25, 2001, at URL http://www.jordanembassyus.org/020320000009.htm).

Silica.—Jordan has substantial reserves of silica sand. The sands at the Ras En Naqab averaged 99.31% SiO_2 and 0.03% Fe_2O_3, while the Qa'a Disi deposit averaged 98.2% SiO_2 and 0.028% Fe_2O_3, and the Wadi Es Sik deposit averaged 98.23% SiO_2 and 0.035% Fe_2O_3. After refining, the Ras En Naqab, the Qa'a Disi, and the Wadi Es Siq sands averaged 99.72% SiO_2, 99.34% SiO_2, and 99.21% SiO_2, respectively. The International Silica Industries Company was established as a public shareholding company to target a market that employs silica sand as a raw material (Al Ali, 2000).

Jordan's principal deposits of tripoli, which is a fine grained crystalline silica commonly used as an abrasive, occur in the Karak District. Reserves were estimated to be 13 Mt at El-Adnanieh and 6.2 Mt at El-Shahabiyeh. Other deposits occur at Ainun, Wadi Falqa, and Wadi Rakin (Jordan Natural Resources Authority, 2000, Nonmetallic minerals—Tripoli, accessed April 25, 2001, at URL http://www.nra.gov.jo/nonmetalic/tripoli.htm). Very limited amounts of this material is being used locally by small companies (Al Ali, 2000).

Other.—Other industrial minerals found in Jordan include apatite, barite, bentonite, clay, and sulfur. The only significant apatite deposit is located near Suweileh. Deposits of barite occur at Aqaba, Beit Sahur, Gharandal, Wadi el Mingar, and Zakimat el Hasa. Bentonite was found in the northern Wadi Sirhan Depression; resources were believed to be 17 Mt. Deposits of clay were found at Mahis, which had estimated resources of 1.9 Mt, and at Ghor Kabid, which had estimated resources of 520,000 t. The sulfur content of Jordan's oil shale ranges from 4% to 5%; estimated total sulfur resources are about 600 Mt (Jordan Natural Resources Authority, 1989, p. 101-102, 106, 139). Building materials found in substantial quantities in Jordan include dimension stone, marble (green, brown with greenish tint, brown, violet, and black), raw materials for brick (found at Mahis), and sand and gravel.

Mineral Fuels

Natural Gas.—Jordan has 6.8 billion cubic meters of natural gas reserves and has developed a single gasfield at Risha in the eastern desert near Iraq. The annual output of around 310 million cubic meters from the Risha field was used to fuel a nearby powerplant, which generated about 12% of Jordan's electricity. Exploration for further reserves of natural gas has not yet been successful; gas production was not expected to increase substantially in the near future (U.S. Energy Information Administration, June 2000, Jordan—Natural gas, accessed April 25, 2001, at URL http://www.eia.doe.gov/emeu/cabs/jordan.html).

Petroleum.—Small reserves of crude oil are found at the Azraq and the Hamza fields. Jordan has one oil refinery at Zarqa with a capacity of 100,000 barrels per day (bbl/d); an expansion of the capacity to 150,000 bbl/d was to be completed by 2003. In 1998, Iraq and Jordan agreed to build a pipeline for the transport of Iraqi oil to the Zarqa refinery. The project was postponed in June 1999 pending an improvement in Jordan's economic situation (Arab Petroleum Research Center, 2000a).

Jordan's oil shale resources were estimated to be about 34 billion barrels (Gbbl). Wadi Maghar accounted for 14 Gbbl; Attarat Um Ghudran, 8.1 Gbbl; El-Thamed, 7.43 Gbbl; Juref-Ed-Darawish, 3.3 Gbbl; El-Lajjun, 821 million barrels (Mbbl); and Sultani, 482 Mbbl (J.R. Dyni, Chairman, Oil Shale Committee, American Association of Petroleum Geologists, February 27, 2000, Oil shale, accessed May 11, 2001, at URL http://www.emdaapg.org/Oil%20Shale.htm). In 1999, the Canadian company Suncor Energy Inc. expressed an interest in exploiting Jordan's shale oil. If Suncor proceeds with the project, then it would plan to produce 17,000 bbl/d within 3 years, 67,000 bbl/d after 5 years, and 210,000 bbl/d after 8 years (Arab Petroleum Research Center, 2000a).

Infrastructure

Jordan produced 7,200 gigawatthours (GWh) of electricity in 2000 (Jordan Central Bank, March 2001, Production, prices, and companies, quantities produced by major industries, CBJ Monthly Statistical Bulletin, accessed April 30, 2001, at URL http://www.cbj.gov.jo/docs/bulletin/ 37.xls). In 1998, fossil fuels accounted for 99.51% of the electricity generated, and hydroelectric power accounted for the remaining 0.49% (U.S. Central Intelligence Agency, 2000a). Installed generating capacity was 1.4 gigawatts (GW) in 2000; an estimated 500 megawatts (MW) was to be installed by 2006. Expansions of capacity include a new 300- to 450-MW plant at al-Samra, and a new 30-MW solar plant at Wadi Rum and doubling the capacity of the 260-MW Aqaba plant (Arab Petroleum Research Center, 2000a). Jordan's known exploitable potential hydroelectric energy was 87 MW (World Resources Institute and others, 1996, p. 288). The most promising sources of geothermal energy are at Zara and Zerqa Ma'in (Jordan Natural Resources Authority, 1989, p. 72).

Jordan's transportation network comprised about 8,000 km of highways and 677 km of railroads. There was 209 km of crude oil pipelines. Aqaba, which is located in the southwestern corner of the country, is Jordan's only port.

Outlook

The outlook for Jordan's phosphate, potash, and salt industries depends heavily upon world market conditions for these commodities. The cement, dimension stone, gypsum, limestone, marble, and natural gas industries are more dependent upon the strength of the Jordanian economy.

LEBANON

The Lebanese minerals industry continued its historically small contribution to the country's economy. In recent years, Lebanon has been known to produce cement, gypsum, lime, salt, and steel for domestic consumption. In 1999, Lebanon's GDP amounted to about $16.2 billion at purchasing power parity, which was an increase of about 1% compared with that of 1998. Per capita income at purchasing power parity was $4,500 in 1999. The output of the industrial sector accounted for about 27% of the GDP (U.S. Central Intelligence Agency, 2000b).

In 1998, total imports were valued at $7.4 billion, the bulk of which were refined petroleum products and ferrous scrap for the Lebanese steel industry (Michalski, 2001). Other mineral imports included phosphate rock and sulfur. Lebanese imports of phosphate rock were 377,221 t in 1999; this was an increase of 4.5% from 1995. Lebanon imported 101,244 t of sulfur in 1999; the country's sulfur imports have more than tripled from their level of 31,700 t in 1995 (British Geological Survey, 2001, p. 210, 255).

Lebanon, which was a net exporter of cement, produced about 3.2 Mt of cement and consumed 2.7 Mt in 2000. Exports of cement rose to 500,000 t in 2000 from 350,000 t in 1999; some cement was exported to Syria. The country's cement factories were owned by Societe des Ciments Libanais, which had a capacity of 2.2 Mt/yr; Cimenterie Nationale, 1.6 Mt/yr; and Ciment de Sibline, 1.2 Mt/yr (International Cement Review, 2001b).

Modest deposits of asphalt, coal, iron ore, lignite, phosphates, and salt occur in Lebanon. All of these resources have been exploited for internal consumption. The country also has several quarries for building stone, limestone, and sand suitable for use in construction (Worldinformation.com, 2000, Lebanon—Country profile, accessed April 24, 2001, at URL http://www.worldinformation.com/World/Asia/Lebanon/profile.asp?country=961).

Because Lebanon has no known gas or petroleum reserves, it relies on imports for its energy requirements. In 1999, Lebanon's imports of refined petroleum products amounted to nearly 5 Mt. The Zahrani and the Tripoli refineries were shut down in 1989 and 1992, respectively. The Government drew up plans to convert power stations from fuel oil to natural gas for cost and environmental reasons. Electricite du Liban (EdL) estimated that switching to natural gas could save $100 million per year. In June 1999, Lebanon and Syria signed an agreement in principle to build a pipeline to supply Lebanon with Syrian natural gas (Arab Petroleum Research Center, 2000b).

Lebanon produced 8,700 GWh of electricity in 1999. Fossil fuels accounted for 90.78% of the electricity generated, and hydroelectric power accounted for the remaining 9.22%. EdL imported 500 MW of electricity from Syria in 1999. In January 2000, Lebanon and Syria renewed their agreement to supply Lebanon with Syrian electricity another 2 years. Lebanon's installed generating capacity was more than 2.0 GW at the beginning of 2000, although effective operating capacity was estimated to be no more than 1.2 GW (Arab Petroleum Research Center, 2000b). Lebanon's known exploitable potential hydroelectric energy is 1.0 GW (World Resources Institute and others, 1996, p. 289).

EdL estimated that installed capacity will have to be expanded to as much as 2.1 GW in 2005 and 2.6 GW in 2010 to meet the growing demand for electricity. Owing to the decommissioning of the 331-MW Jieh and the 65-MW Al Haricha plants by 2006, the installation of 750 MW of new capacity will be necessary. EdL did not have the estimated $1 billion needed to build the new powerplants and to upgrade the transmission and distribution network. In 1999, the Lebanese government decided to privatize the power industry (Arab Petroleum Research Center, 2000b).

Lebanon's transportation network comprised about 7,300 km of roads, of which 6,200 km was paved. Railroad track totaled 399 km, most of which were damaged during the civil war. The country had 72 km of crude oil pipelines, but none was operational. Ports and harbors were Antilyas, Batroun, Beirut, Chekka, El Mina, Ez Zahrani, Jbail, Jounie, Naqoura, Sidon, Tripoli, and Tyre (U.S. Central Intelligence Agency, 2000b).

The success of the Lebanese minerals industry depends upon the long-term restoration of peace and stability to the country. The International Cement Review (2001b) predicted that the production and consumption of cement in Lebanon would decline modestly in 2001.

SYRIA

The Middle Eastern nation of Syria was a producer of dimension stone, fertilizers, gravel, industrial minerals, natural gas, oil, sand, and semimanufactured goods. Industrial minerals produced in recent years have included gypsum, phosphate rock, salt, and sulfur. Semimanufactured goods included cement and crude steel.

Syria's 1999 GDP at purchasing power parity was estimated to be $42.2 billion. Per capita GDP at purchasing power parity was $2,500 (U.S. Central Intelligence Agency, 2000c). Following 2 years of recession caused by low oil prices and a severe drought, Syria's economy resumed growth in 2000, and inflation remained subdued. For 2000, Syria's real GDP grew by 1.5%. Oil, which is critical to Syria's economy, accounted for 55% to 60% of Syria's total export earnings and more than one-third of its GDP (U.S. Energy Information Administration, February 2001, Syria—Recent developments, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

Commodity Review

Industrial Minerals

Cement.—Seven state-owned but independently operated companies within The General Organization for Cement and Building Materials produced cement. In 2000, Syria produced about 4.8 Mt of cement (table 1) and consumed 5.0 Mt. The production and consumption of cement increased from 1999. Imports were 200,000 t in 1999 and 2000; Syria imported some cement from Lebanon (International Cement Review, 2001c). In September, Saudi Cement Company was given permission to build a $537 million 3-Mt/yr cement plant in Syria (Building Bulletin, 2000). In December, Iran Industries Construction Company announced its intention to build a $196 million cement plant in Syria (Iran Daily, 2000a).

Fertilizer.—Syria has considerable deposits of phosphate rock; known phosphate rock reserves are 1.7 Gt. The majority of Syria's phosphate rock reserves are located 170 km northeast of Damuscus. In 2000, Syria was the world's third largest exporter of phosphate rock after Morocco and Jordan; most phosphate rock was exported to Asia, Europe, and North America, and the remainder was used for domestic fertilizer production (Arabia Online Ltd., January 18, 2001, Syria phosphate reserves up to 1.7 bln tonnes, accessed April 24, 2001, at URL http://www.arabia.com/Business/article/english/0,1690,37839,00.html).

Syria's abundant phosphate reserves and rising natural gas production have led to plans for expanding fertilizer production capacity. In 2000, Syria had two nitrogenous fertilizer plants and one phosphate-based unit at Homs. Domestic demand for phosphate fertilizers was more than 400,000 t/yr, but phosphate fertilizer plant production was only 250,000 t/yr. A 500,000-t/yr triple superphosphate plant was being constructed near Palmyra by Bechtel Corp. and Makad International. This plant would obtain phosphates from the Khunaifis Mines. For nitrogenous fertilizers, Syria also planned to build a plant with a production capacity of 365,000 t/yr of ammonia and 639,000 t/yr of urea. This plant would use gas from the Omar field (Arab Petroleum Research Center, 2000c, p. 443).

Sulfur.—Syria produced sulfur as a byproduct of oil refining. The General Establishment for Chemical Industries operated a 150-metric-ton-per-day-capacity sulfur plant in Homs (British Sulphur Publishing, 1999, p. 32).

Mineral Fuels

Natural Gas.—Syria's proven natural gas reserves were estimated at 241 billion cubic meters. Most of these reserves were owned by the Syrian Petroleum Company (SPC), which was a state-owned company. The Palmyra area contained 102 billion cubic meters; the al-Furat fields, 45 billion cubic meters;

Suwaidiyah, 34 billion cubic meters; Jibsah, 23 billion cubic meters; Deir ez-Zour, 20 billion cubic meters; and at al-Hol, al-Ghona, and Marqada, the remainder. About half of Syria's gas is nonassociated. In June 1999, SPC reportedly discovered a new gasfield called North al-Faydh (U.S. Energy Information Administration, February 2001, Syria—Natural gas, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

In 1999, Syria produced about 6.2 billion cubic meters of natural gas, which was an approximately fivefold increase compared with that of the past decade (Arab Petroleum Research Center, 2000c, p. 437). Syria planned to increase production further (possibly doubling by 2005) as part of a strategy to substitute natural gas for oil in power generation.

The Syrian natural gas industry has been facing logistical challenges. Gas reserves are located mainly in northeastern Syria, but population and end users are centered in the western and southern parts of the country. SPC has invited foreign energy companies to submit proposals on gas development projects in the Palmyra region, which is in central Syria (U.S. Energy Information Administration, February 2001, Syria—Natural gas, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html). At the end of 1999, Al-Sokhnah and the Najib fields were developed in the Palmyra region; each has a production capacity of 1.5 million cubic neters per day. Al-Abbas, Al-Rasem, Al- Sharif, the Kom Abu Arabat, the Rasif, and the Zamlakh fields were estimated to have a total production potential of 5.65 million cubic meters per day and were expected to come on-stream in 2002 (Arab Petroleum Research Center, 2000c, p. 437).

Other sources of new natural gas production will come from the Dez Gas project. In November 1998, SPC awarded a contract worth $430 million to TotalFinaElf SA and Conoco Inc. for the recovery of associated gas from the Deir ez-Zor oilfields. A new gas-processing plant with a capacity of 5 Mm^3/d and associated gas gathering and transmission facilities was scheduled for completion in September 2001. In 2000, gas-processing plants included Omar with a capacity of 2.4 billion cubic meters per year; Palmyra, 2.2 billion cubic meters per year; Jbeisseh, 1.06 billion cubic meters per year; and Suwaidiyah, 240 million cubic meters per year (Arab Petroleum Research Center, 2000c, p. 438).

Petroleum.—Official and independent sources have estimated Syria's oil reserves to be 2.5 Gbbl. Suwaidiyah was the largest oilfield; its reserves were originally more than 1 Gbbl. Omar has recoverable reserves of 200 Mbbl, and Al-Thayyem has reserves of 180 Mbbl (Arab Petroleum Research Center, 2000c, p. 431).

The SPC operated fields of heavy crude oil in northeastern Syria. The company's largest fields were Jibsah, which also produces natural gas; Karatchok; and Suwadiyah. TotalFinaElf and Royal Dutch/Shell Group bid on a service contract to enhance oil recovery and to increase production at Karatchok to 150,000 bbl/d. Smaller fields included Alian, Gbebeh, Rumailan, and Tishreen. SPC's oilfields produced 140,000 bbl/d in 1999 (Arab Petroleum Research Center, 2000c, p. 432).

SPC also owned 50% of Syria's largest oil producer Al-Furat Petroleum Company (AFPC). Other partners in AFPC were Germany's Deminex GmbH (18.75%), Pecten Syria Petroleum (15.625%), and Royal Dutch/Shell (15.625%). AFPC's fields are located in northeastern Syria and produced light crude oil (U.S. Energy Information Administration, February 2001, Syria—Oil, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

In 1999, AFPC produced 330,000 bbl/d of oil, which was about 61% of Syria's total crude petroleum production. The company's main oilfields were al-Thayyem (60,000 bbl/d), Al-Izba (55,000 bbl/d), Omar/Omar North (45,000 bbl/d), Maleh/Azraq (35,000 bbl/d), Sijan (35,000 bbl/d), Jarnof/Saban (30,000 bbl/d), Al-Ward (25,000 bbl/d), and Tanak (18,000 bbl/d). Other AFPC oilfields included Abu Hardan, Jazieh, Shdeha, and Tayani. In May 1999, the company awarded a contract to Engineering for the Petroleum and Process Industries to increase the capacity of its crude-oil-gathering centers (Arab Petroleum Research Center, 2000c, p. 431, 432, 434).

In May 2000, Canada's Tanganyika Oil Company Ltd., which was an affiliate of Sweden's Lundin Oil AB, signed an agreement to develop the Oude oil block in northeastern Syria. The deal marked the first time that foreign investment had been sought for a field operated by SPC. This opened up the possibility of future deals; for example, the Suwaidiyah field for which Conoco, TotalFinaElf, and Shell have bid (U.S. Energy Information Administration, February 2001, Syria—Oil, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

The Deir ez-Zor Petroleum Company operated the Attala North, the Jafra, and the Qahar oilfields, which produced 60,000 bbl/d in 1999. The Al-Khabur Petroleum Company (a joint venture between SPC (50%) and a consortium composed of Clyde Petroleum Exploration Ltd., Petronas Carigali Sdn Bhd, Premier Pict Petroleum Ltd., and Seafield Resources plc.) operated the Kishma oilfield, which produced 12,000 bbl/d (Arab Petroleum Research Center, 2000c, p. 434).

Syria's two refineries, which were located at Banias and Homs, had production capacities of 135,000 bbl/d and 107,140 bbl/d, respectively. Syria was planning to construct a third refinery with a capacity of 60,000 bbl/d (possibly increasing to 120,000 bbl/d) at Deir ez-Zor to supply products to the eastern part of the country. Additionally, Syria planned to upgrade its two existing refineries, both of which were in urgent need of overhauling, to replace output of fuel oil with light products (U.S. Energy Information Administration, February 2001, Syria—Oil, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

In November, Syria and Iraq reopened the Kirkuk-Banias pipeline. The Iran Daily (2000b) reported initial deliveries of Iraqi crude oil through the pipeline at around 150,000 bbl/d. The oil, most likely Basra Light, could be used in Syrian domestic refineries, thus freeing up more Syrian crude oil for export to world markets to generate additional export revenues.

Infrastructure

Syria's hydroelectric powerplants had total designed capacity of about 900 MW, but effective operating capacity was about 200 MW owing to technical problems and low water levels in Lake Assad (Arab Petroleum Research Center, 2000c, p. 440). Syria's known exploitable potential hydroelectric energy was 4.5 GW (World Resources Institute and others, 1996, p. 289).

As of 1999, total installed Syrian electric generating capacity was 4.5 GW. With Syrian electricity demand growing at about the same pace as the economy, adding new capacity will be an important national priority. Since 1993, existing power stations have undergone maintenance, and four generating plants have been built. Mitsubishi Heavy Industries Ltd. completed the 600-MW Al-Zara plant near Hama in November 2000. Also planned were the 300-MW Zeizoun plant and the 630-MW Tishreen hydro station. Overall, Syria planned to add 3.0 GW of capacity between 2004 and 2010 (U.S. Energy Information Administration, February 2001, Syria—Electric power, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

As part of its strategy to save oil for export to earn hard currency, Syria planned to build several natural gas combined-cycle powerplants and to convert the country's largest oil-fired powerplants to natural gas. The Banias and the Mahrada plants have been converted from fuel oil to natural gas in recent years; gas for these two plants has been coming from the Palmyra fields. Syria also planned to increase gas usage at the dual-fuel (fuel oil or natural gas) Tishreen powerplant; gas for Tishreen will be supplied by the Omar treatment plant.

Syria was also pursuing nuclear power as an alternative to oil-fired plants. On May 19, 1999, Syria signed an agreement with Russia on cooperation in nuclear power; this included the construction of two nuclear reactors in Syria. In 1998, the two countries had agreed on a timetable for a 25-MW light-water nuclear powerplant in Syria with the participation of Russia's Atomstroyeksport and Nikiet (U.S. Energy Information Administration, February 2001, Syria—Electric power, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

In 1999, Jordan and Syria signed a formal agreement to connect their power grids. In the same year, Syria and Iran signed an agreement on electric power cooperation. Syria's power distribution system suffered from transmission losses as high as 25% of total generated capacity owing to poor-quality wires and outdated transformer stations. In December 2000, the European Investment Bank agreed to lend Syria $69 million for the expansion and upgrading of the country's power transmission network. The project, which was scheduled for completion by 2005, will also be funded by Arab Gulf states and the Syrian Government (U.S. Energy Information Administration, February 2001, Syria—Electric power, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

Outlook

The International Cement Review (2001c, p. 282) predicted that the production and consumption of cement in Syria would increase modestly in 2001. The increased demand for construction materials may also lead to greater production of gravel, gypsum, marble, and sand.

Syria's oil industry was expected to face many challenges in the coming years. Oil production continues to decline owing to technological problems and depletion of reserves. Since peaking in 1996, Syria's oil output has fallen steadily as older fields, especially the Jebisseh field, have reached maturity (table 1). During the next several years, analysts expect production to continue to decline, net oil exports to decline, and consumption to rise. If future oil and gas exploration and production efforts are successful, then the problem of resource depletion may be significantly alleviated (U.S. Energy Information Administration, February 2001, Syria—Oil, accessed May 3, 2001, at URL http://www.eia.doe.gov/emeu/cabs/syria.html).

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TABLE 1
JORDAN, LEBANON, AND SYRIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Country and commodity		1996	1997	1998	1999 e/	2000 e/
JORDAN						
Cement, hydraulic	thousand tons	3,512 r/	3,251 r/	2,650 r/	2,687 r/ 3/	2,640 3/
Clay:						
Common clay		NA	843,986	590,897	450,178 3/	199,468 3/
Kaolin		47,500	57,255	78,000	34,040 r/ 3/	36,795 3/
Zeolite tuff		NA	NA	NA	13,086 3/	9,797 3/
Feldspar		2,500 e/	--	4,008	1,000 r/ 3/	11,112 3/
Gypsum		190,000	193,527	175,807	244,920 r/ 3/	157,868 3/
Kaolin		47,500	57,255	78,000	34,040 r/ 3/	36,795 3/
Lime		7,275	4,263	4,064	4,120 r/	4,050
Natural gas, gross	million cubic meters	200 e/	291	264	282 r/ 3/	287 3/
Petroleum:						
Crude	42-gallon barrels	16,000 e/	14,680	12,400	-- 4/	--
Refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	1,500 e/	1,542	1,660	1,505 r/ 3/	1,684 3/
Gasoline	do.	4,500 e/	4,469	5,429	4,685 r/ 3/	4,957 3/
Jet fuel	do.	300 e/	253	245	1,722 r/ 3/	1,950 3/
Kerosene	do.	1,500 e/	1,507	1,517	1,382 r/ 3/	1,991 3/
Distillate fuel oil	do.	6,500 e/	6,920	6,882	8,222 r/ 3/	10,001 3/
Residual fuel oil	do.	7,000 e/	7,326	7,105	-- r/ 3/	-- 3/
Other	do.	1,000 e/	866	783	830 r/ 3/	688 3/
Total	do.	22,300 e/	22,883	23,621 r/	18,346 r/	21,271
Phosphate:						
Mine output:						
Gross weight	thousand tons	5,355	5,896	5,925 r/	6,014 3/	5,458 3/
P_2O_5 content	do.	1,765	1,946 r/	1,955 r/	1,924 r/ 3/	1,746 3/
Phosphatic fertilizers		639,800	576,142	579,835	613,821 r/ 3/	409,149 3/
Phosphoric acid		NA	37,761	68,345	372,169 r/ 3/	178,701 3/
Potash:						
Crude salts	thousand tons	1,765	1,416 r/	1,527 r/	1,800	1,936 3/
K_2O equivalent	do.	1,080	850 r/	916 r/	1,080 r/	1160 3/
Salt		50,000 r/	157,830 r/	263,314 r/	279,135 r/ 3/	311,189 3/
Sand, silica	cubic meters	NA	NA	NA	52,224 3/	47,218 3/
Steel, crude e/		30,000	-- r/ 3/	-- r/ 3/	--	--
Stone:						
Dimension, worked	thousand meters	6,000 e/	6,308	6,205	6,303 r/ 3/	3,508 3/
Gravel and crushed rock e/	thousand cubic meters	NA	NA	NA	12,180 3/	10,381 3/
Limestone	do.	8,000 e/	12,388	8,031	8,000	8,000
Marble	cubic meters	100,000 e/	57,550 r/	134,670 r/	10,250 r/ 3/	21,575 3/
LEBANON e/						
Cement, hydraulic	thousand tons	3,500	2,703 3/	3,310 r/ 3/	3,200 r/ 3/	3,200
Gypsum		1,980 r/	1,530 r/	1,870 r/	1,810 r/	1,810
Iron and steel, metal, semimanufactures		80,000	80,000	80,000	80,000	80,000
Lime		14,800 r/	11,400 r/	14,000 r/	13,500 r/	13,500
Salt		3,500	3,500	3,500	3,500	3,500
SYRIA						
Cement, hydraulic	thousand tons	4,500 e/	4,840 r/	4,607 r/	4,781 r/ 3/	4,830
Gas, natural:						
Gross e/	million cubic meters	5,500	6,400	8,000	9,000	9,000
Dry	do.	2,900 r/	4,560	5,900 r/	6,200 3/	6,200
Gypsum e/		338,000 r/	364,000 r/	346,000 r/	359,000 r/	363,000
Iron and steel, steel, crude e/		70,000	70,000	70,000	70,000	70,000
Natural gas liquids	thousand 42-gallon barrels	2,928 r/	3,650 r/	2,928 r/	2,928 r/	3,000
Nitrogen:						
N content of ammonia		80,400	83,700	129,200	111,800 3/	91,100 3/
N content of urea		46,000	54,400	79,600 r/	73,400 3/	56,600 3/
Petroleum:						
Crude		220,500	204,800	202,000	196,000	194,000
Refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	2,122	2,170	2,215	2,200	2,200
Gasoline	do.	11,406	11,400	11,785	11,700	11,700
Naphtha	do.	1,685	1,700	1,710	1,700	1,700
Jet fuel	do.	1,728	1,725	2,029	2,000	2,000

See footnotes at end of table.

TABLE 1--Continued

JORDAN, LEBANON, AND SYRIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Country and commodity		1996	1997	1998	1999 e/	2000 e/
SYRIA--Continued						
Petroleum--Continued:						
Refinery products--Continued:						
Kerosene	thousand 42-gallon barrels	1,491	1,500	1,546	1,500	1,500
Distillate fuel oil	do.	30,078	30,600	30,772	30,600	30,700
Residual fuel oil	do.	35,038	35,000	34,978	34,800	34,900
Asphalt	do.	1,916	1,900	1,900	1,900	1,900
Other	do.	1,900	1,900	2,000	2,000	2,000
Total	do.	87,364	87,895	88,935 r/	88,400 r/ 3/	88,600 3/
Phosphate rock:						
Gross weight	thousand tons	2,189	2,392	2,496	2,084 r/ 3/	2,166 3/
P_2O_5 content	do.	670	730	765 r/	635	658
Salt		72,000	119,000 r/	163,452	150,000 3/	150,000
Stone, sand and gravel: e/						
Stone, dimension, marble	thousand cubic meters	1,156 3/	1,150	1,200	1,200	1,200
Sand and gravel	thousand tons	4,200	4,200	4,200	4,000	4,000
Sulfur, byproduct of petroleum and natural gas		30,000 r/	30,000 r/	30,000 r/	30,000 r/	30,000

e/ Estimated. r/ Revised. NA Not available. -- Zero.

1/ Table includes data available through May 4, 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ Reported figure.

4/ Crude oil production from the Hamza field ceased.

THE MINERAL INDUSTRY OF

SAUDI ARABIA

By Philip M. Mobbs

In 2000, Saudi Arabia accounted for about 12.3% of the total world output of crude oil. To meet the increased international demand for petroleum, Saudi Arabia, which was the swing producer for the Organization of the Petroleum Exporting Countries (OPEC), increased output by 7.3% in 2000 compared with that of 1999. Despite the increased crude oil flows in 2000, national output still was less than 90% of sustainable crude production capacity. Petroleum accounted for about 90% of Saudi Arabia's export earnings and about 70% of Government revenues.

In 2000, the gross domestic product (GDP) at current prices was estimated by the Saudi Arabian Monetary Agency to be \$173 billion[1] (Middle East Economic Digest, 2001a). Crude oil and natural gas production was valued at \$71 billion. In 2000, crude oil and natural gas production accounted for about 42% of the GDP, petroleum refining accounted for about 3% of the GDP, and about 0.4% of the GDP was attributed to other mineral production (Saudi Arabian Monetary Agency, [undated], Gross domestic product by type of economic activity [at producers' values at current prices], accessed August 1, 2001, via URL http://www.sama.gov.sa/reports/annual/reports/tab5-1w.htm).

Government Policies and Programs

A new Foreign Investment Act was ratified in 2000. Under the new law, international investors acquired the same rights and privileges as Saudi Arabian investors. The Government continued working on the proposed opening of the energy sector to international oil companies that originally had been broached in 1998 and assessed foreign oil companies' suggested investment opportunities that could be included under the program. The Government announced that international oil companies would be considered for the development of three initial gas initiative projects—the Haradh (South Ghawar area), the Kidan/Shaybah, and the Rabigh/Midyan (Red Sea area) (Alexander's Gas & Oil Connections, August 7, 2000, Saudi Arabia presents oil companies with three core projects, accessed September 7, 2000, at URL http://www.gasandoil.com/goc/news/ntm03262.htm).

In January, the Government established the Supreme Council for Petroleum and Mineral Affairs.

Work on the Saudi Strategic Storage project (SSSP) continued. The SSSP had been envisioned in 1994 to assure refined petroleum products supply and distribution in the kingdom. Government-owned Saudi Aramco assumed control of the initial underground storage facility in 2000. The project's construction phase was scheduled to be completed by 2009.

Production

Mineral and mineral-based commodity production in Saudi Arabia included barite, cement and other industrial and construction materials, copper, nitrogenous and phosphatic fertilizers, natural gas, gold, oil, petrochemicals, refined petroleum products, salt, silver, sulfur, and zinc. Steel was produced from scrap and imported iron ore pellets.

In 2000, the average production of crude oil and condensate, which included the Saudi Arabian share of production from the partitioned neutral zone shared with Kuwait, was 9.2 million 42-gallon barrels per day (Mbbl/d) (U.S. Energy Information Administration, June 2001, Saudi Arabia—Oil, accessed July 31, 2001, at URL http://www.eia.doe.gov/emeu/cabs/saudi.html). Although actual sustainable production capacity was reported to be about 10.5 Mbbl/d, Saudi Arabian output has been restricted to about 9 Mbbl/d in recent years in accordance with the quota assigned by OPEC (U.S. Energy Information Administration, 2001). In 2000, Saudi Arabia's unused production capacity of 1.3 Mbbl/d was equivalent to about half of Iraq's 2.6-Mbbl/d production and exceeded the output from Brazil, which was the 18th largest crude oil producer in the world (BP p.l.c., June 2001, Oil production, accessed August 1, 2001, at URL http://www.bp.com/centres/energy/world_stat_rev/oil/production.asp).

Trade

Total exports from Saudi Arabia in 2000 were valued at \$79 billion (Middle East Economic Digest, 2001a). In 1999 (the last year for which sector data were available), mineral products, primarily crude oil and petroleum products, accounted for 89% of total exports, which were valued at \$51 billion (Saudi Arabian Monetary Agency, [undated], Composition of exports, accessed August 1, 2001, at URL http://www.sama.gov.sa/reports/annual/reports/tab6-2.htm).

About 41% of Saudi Arabian crude oil was shipped to Asia, and 23%, to the United States. Asia also received 63% of Saudi Arabian natural gas liquids exports and 61% of refined petroleum products exports. Imports into the United States of crude oil and products from Saudi Arabia were reported to be about 1.57 Mbbl/d in 2000, which accounted for about 17% of total U.S. crude oil imports (U.S. Energy Information Administration, June 2001, Saudi Arabia—Oil, accessed July 31, 2001, at URL http://www.eia.doe.gov/emeu/cabs/saudi.html).

Saudi Arabia's total imports were valued at about \$27 billion in 2000 (Middle East Economic Digest, 2001a). The United States remained the largest supplier to the kingdom and accounted for about 19% of the country's imports. In 1998 (the last year for which there were discrete data), total imports were valued at $30 billion, of which aluminum accounted for $278 million; iron ore, $126 million; ornamental stone, $71 million; refractory brick, $30 million; titanium ore, $22 million; zinc and zinc alloy, $22 million; and cement, $16 million (United Nations, 2000).

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[1] Where necessary, values have been converted from Saudi riyals (SRls) to U.S. dollars at the rate of SRls3.75=US\$1.00.

Structure of the Mineral Industry

All minerals, which included natural gas and petroleum, were owned by the Government. The state-owned Saudi Arabian Mining Co. (Ma'aden), which was created in 1997, actively participated in and promoted mineral exploration and mining activities throughout the kingdom. In 2000, Saudi Aramco was the only company authorized to engage in oil and gas exploration and field development within Saudi Arabia, although many industrial projects in the petrochemical and petroleum-refining sectors were joint ventures between Saudi firms and international companies.

The concession of the Arabian Oil Co., Ltd., of Japan (AOC) to operate in the Saudi Arabian-administered section of the partitioned neutral zone expired early in the year. AOC continued to work in the Kuwaiti-administered section of the partitioned neutral zone with Kuwait Oil Co. and Saudi Arabian Texaco Inc. Saudi Aramco created a subsidiary, Aramco Gulf Operations Co. Ltd., to replace AOC in the Saudi Arabian-administered zone.

Affiliated companies of Saudi Basic Industries Corp., which included the Saudi Arabian Fertilizer Co. (SAFCO), the Saudi Iron and Steel Co. (Hadeed), and the Saudi Petrochemical Co., were involved in the manufacture of chemicals, fertilizers, and steel.

Commodity Review

Metals

Bauxite.—Ma'aden indicated that development of the remote Az Zabirah bauxite deposit would depend on the building of a regional transportation network (Abdullah Al-Dabbagh, Saudi Arabian Mining Co. [Ma'aden], Ma'aden—A new Saudi Arabian thrust into gold and minerals, accessed August 2, 2001, at URL http://www.us-saudi-business.org/dabbagh.htm). Az Zabirah had minable resources of 102 million metric tons (Mt) at a grade of 58.05% Al_2O_3 and 5.46% SiO_2 (Collenete and Grainger, 1994a).

Gold.—About 2,200 kilograms (kg) of gold was produced at the Mahd Adh Dhahab underground mine and 1,500 kg at the Sukhaybirat open pit mine. The open pit Al-Amar Mine, which was 220 kilometers (km) southwest of Riyadh, began operations in late 2000 and was expected to produce 1,500 kg of gold and 7,300 kg of silver in 2001. Ma'aden estimated that Al-Amar had reserves of 3.2 Mt at a grade of 3.28 grams per metric ton (g/t) gold. In 2000, feasibility studies were undertaken for the Al-Hajar underground and the Balghah open pit projects. Al-Hajar's North Vein zone had estimated resources of 1.07 Mt at a grade of 33.1 g/t gold, and resources at the Southwest Stockwork area were estimated to be 1.145 Mt of ore at a grade of 9.4 g/t gold. Balghah's resources were estimated to be 40 Mt at a grade of about 1 g/t gold (Collenete and Grainger, 1994b, p. 99; Abdullah Al-Dabbagh, President and CEO, Saudi Arabian Mining Co. [Ma'aden], February 29, 2000, Ma'aden—A new Saudi Arabian thrust into gold and minerals, accessed August 2, 2001, at URL http://www.us-saudi-business.org/dabbagh.htm).

Iron and Steel.—Hadeed successfully completed the installation of an 850,000-metric-ton-per-year (t/yr)-capacity flat steel facility at its Al Jubayl steel plant (Middle East Economic Digest, 2001b). The Al Jubayl plant included a direct-reduction iron plant built in 1999, an 850,000-t/yr steel plant, the 850,000-t/yr hot strip rolling mill, a 496,000-t/yr cold rolling mill, and a 200,000-t/yr hot dip galvanizing line (Saudi Basic Industries Corp., 2001, Products—Metals, accessed August 2, 2001, at URL http://www.sabic.com/en/products/metals/flat.html). The plant was engineered to allow for expansion to 4.3 million metric tons per year of rolled products. After the flat steel facility opened, Hadeed announced that it would close the 140,000-t/yr-capacity Jeddah rolling mill (Metal Bulletin, 2000a).

In July, United Gulf Steel Mills Co. Ltd. opened a 500,000-t/yr-capacity medium-section rolling mill in Al Jubayl (Metal Bulletin, 2000b).

Industrial Minerals

Fertilizer.—Three companies produced fertilizer in Saudi Arabia, the Al Jubayl Fertilizer Co., the National Chemical Fertilizer Co. (Ibn Al-Baytar), and SAFCO. In January 2000, SAFCO began production at its third ammonia and urea facility, the new 500,000-t/yr-capacity ammonia, and 600,000-t/yr-capacity urea plant at Al Jubayl. In August, a proposed expansion of the Ibn Al-Baytar ammonia plant in Al Jubayl to 583,000 t/yr from 500,000 t/yr was announced (Saudi Basic Industries Corp., 2000a).

In 2000, National Industrial Gases Co. (GAS) initiated krypton-xenon gas production at its Al Jubayl air separation plant which was configured to allow for production of 600,000 t/yr of nitrogen for the fertilizer plants in Al Jubayl (Saudi Basic Industries Corp., 2000b). GAS also produced argon for Hadeed's Al Jubayl steel plant.

Magnesite and Phosphate.—In 2000, the magnesite deposit at Zaghat was being evaluated and Ma'aden completed a feasibility study of the Al Jalamid phosphate deposit.

Mineral Fuels

Natural Gas.—The successful 2000 exploration program added 167 million cubic meters per day to nonassociated natural gas reserves with the discovery of two new gasfields (the Ghazal, about 100 km west of Haradh, and the Manjurah, about 30 km west of Haradh) and three new gas reservoir discoveries in the existing Hawiyah, Mazalij, and Niban Fields. When the Ghazal and the Manjurah discoveries are developed, Saudi Arabia would have 87 oil and gasfields.

The expansion of the kingdom's master gas system continued in 2000. Saudi Aramco increased the processing capacity of the Berri, the Shedgum, and the 'Uthmaniyah gas plants to 167 million cubic meters per day. The 40-million-cubic-meters-per-day Hawiyah gas-processing plant was under construction. Scheduled to open in late 2001, the Hawiyah plant also was designed to handle 170,000 42-gallon barrels per day (bbl/d) of condensate and 1,000 metric tons per day of sulfur (Saudi Aramco, 2001, p. 26-27). A feasibility study of the 45-million-cubic-meter-per-day Haradh gas plant was completed in 2000. The plant's construction schedule proposed a December 2003 startup.

Petroleum.—Saudi Aramco began a long-term field study of the Ghawar Field, which was the world's largest onshore field, to improve predictions of reservoir characteristics and recovery and redevelopment models.

The company's refineries completed the Government-mandated switch to unleaded gasoline before year's end. Lead additives were replaced with the oxygenate methyl tertiary butyl ether. The Rabigh refinery increased its maximum sustained capacity to 425,000 bbl/d from 400,000 bbl/d (Saudi Aramco, 2001, p. 33).

Reserves

Saudi Arabia's crude oil reserves represent more than 25% of the total proven world reserves (U.S. Energy Information Administration, 2001, p. 111-113). Saudi Aramco (2001, p. 23) reported that proven oil reserves were 259.25 billion barrels. The bulk of the kingdom's reserves were contained in a few fields in the northeast. These included the Ghawar Field and the Safaniya Field, which was the world's largest offshore oilfield.

Natural gas reserves were reported to be 6.2 trillion cubic meters (Saudi Aramco, 2001, p. 23). Most of Saudi Arabian natural gas reserves were associated with the country's oilfields; the Ghawar Field accounted for about 35% of the total gas reserves.

Outlook

Because most of the national income is dependent upon markets outside the kingdom, the economy remains vulnerable to sudden changes in volume and pattern of worldwide trade in crude, petrochemicals, and refined petroleum. The proposed gasfield development and new transmission facilities associated with the ongoing expansion of Saudi Arabia's natural gas capacity should be developed within the next 5 years, assuming no hitch in financing associated with a major unforseen decline in world oil prices. Saudi Aramco intends to maintain sustainable crude oil production capacity of approximately 10.5 Mbbl/d to abide with OPEC production constraints. The company was expected to shut in less-profitable heavy-crude fields as new fields, which contain lighter premium crudes, are brought on line.

The Government also was considering a revised mineral policy to attract additional investment in the mining sector. Several metal and industrial mineral mining projects were expected to come on-stream within the next 10 years.

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TABLE 1
SAUDI ARABIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1996	1997	1998	1999	2000 e/
METALS						
Ore, mine output:						
Gross weight e/		1,569,205 4/	1,600,000	1,700,000	1,680,000	1,700,000
Copper content of concentrate and bullion 5/		834 e/	703	782	821	900
Gold content of concentrate and bullion 5/	kilograms	7,530	7,260	5,100	4,570	3,800
Lead content of concentrate e/ 5/		50	50	60	50	50
Silver content of concentrate and bullion 5/	kilograms	16,608	17,200	13,840	10,470	9,300
Zinc content of concentrate e/ 5/		500	619	3,550 4/	3,161 4/	3,000
Iron and steel:						
Direct-reduced iron	thousand tons	2,296 4/	2,110	2,268	2,343	3,090 4/
Steel, crude	do.	2,683	2,539	2,356	2,610	2,973 4/
Ferroalloys e/		20,000	83,000	83,000	83,000	83,000
INDUSTRIAL MINERALS						
Barite e/		8,000	8,000	8,000	7,000	8,000
Cement, hydraulic	thousand tons	16,437	15,400	14,000 e/	16,313 r/ 4/	18,107 4/
Fertilizer, phosphatic, P_2O_5 content	do.	122	112	130	145	147
Gypsum, crude		362,589	365,000 e/	330,000 e/	380,000 r/ 4/	400,000
Lime e/		180,000	180,000	200,000	340,000 r/ 4/	350,000
Nitrogen:						
N content of ammonia	thousand tons	1,386	1,405	1,418	1,402	1,743 4/
N content of urea	do.	1,010	930	1,024	1,002	1,214 4/
Pozzolan e/		144,000	145,000	145,000	140,000	150,000
Salt e/		140,000	140,000	140,000 r/	200,000 r/ 4/	200,000
Sand and gravel e/	thousand tons	110,000	110,000	100,000	120,000 r/	120,000
Scoria e/	do.	2,000	2,000	2,000	2,000 4/	2,000
Sulfur, byproduct, hydrocarbon processing		1,741,900 r/	1,700,543 r/	1,880,105 r/	1,939,758 r/	2,101,391 4/
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural: 6/						
Gross	million cubic meters	77,700	81,900	83,000	89,000 e/	96,000
Dry	do.	41,340	45,300	46,700	46,200 r/ e/	58,870
Natural gas liquids: e/						
Propane	thousand 42-gallon barrels	160,000 r/	159,000 r/	159,000 r/	153,000 r/	163,000
Butane	do.	65,400 r/	69,000 r/	69,000 r/	66,200 r/	69,000
Natural gasoline and other	do.	51,600 r/	52,000 r/	51,000 r/	50,000 r/	53,000
Total	do.	276,750 r/ 4/	280,119 r/ 4/	279,163 r/ 4/	269,134 r/ 4/	285,008 4/
Petroleum:						
Crude 7/	million 42-gallon barrels	2,999	3,050 r/	3,170 r/	2,860 r/	3,360
Refinery products:						
Liquefied petroleum gases	thousand 42-gallon barrels	15,424 r/	14,447 r/	11,929 r/	12,533 r/	9,634 4/
Gasoline and naptha	do.	142,164 r/	138,740 r/	142,606 r/	148,853 r/	155,556 4/
Jet fuel and kerosene	do.	64,058 r/	60,844 r/	53,243 r/	60,638 r/	66,920 4/
Distillate fuel oil	do.	192,509 r/	191,948 r/	193,328 r/	188,848 r/	198,176 4/
Residual fuel oil	do.	181,059 r/	165,375 r/	176,460 r/	164,032 r/	163,941 4/
Unspecified 8/	do.	5,387 r/	6,934 r/	6,533 r/	6,625 r/	8,083 4/
Total	do.	600,601 r/	578,288 r/	584,099 r/	581,529 r/	602,310 4/

e/ Estimated. r/ Revised.

1/ Table includes data available through August 2, 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ In addition to commodities listed, the following were produced: basalt, clays, granite, limestone, marble, methanol, nitrogenous fertilizers, silica sand, and sodium hydroxide (caustic soda); but available information is inadequate to estimate output.

4/ Reported figure.

5/ Mahd Adh Dhahab Mine produced a bulk flotation concentrate that contains copper, gold, lead, silver, and zinc and a crude bullion that contains copper, gold, and silver.

6/ Includes Saudi Arabian share (50%) of production from the Saudi Arabian-Kuwaiti partitioned neutral zone.

7/ Includes condensate. Series is a calculation based on 365 days of the reported daily average production; however, reported daily averages vary widely by source. Actual reported Saudi Aramco crude oil production, in million barrels: 2,878 in 1996; 2,829 in 1997; 2,922 in 1998; 2,655 in 1999; and 2,847 in 2000. Saudi Aramco data do not include lease condensate nor the Saudi Arabian share of production from the partitioned neutral zone.

8/ Includes asphalt.

THE MINERAL INDUSTRY OF

TURKEY

By Philip M. Mobbs

Best known for its industrial minerals, Turkey was a major producer of barite, boron minerals, celestite (strontium), emery, feldspar, limestone, magnesite, marble, perlite, and pumice in 2000. A wide variety of primary metallic minerals were produced as well, but output generally was not considered to be large compared with that of other countries. Turkey was a significant world producer of such processed mineral commodities as refined borates and related chemicals, cement, ceramics, and glass and was a notable producer of ferrochromium and steel.

In 2000, the gross domestic product (GDP) was estimated to be about $200 billion[1] in current [2000] dollars (World Bank, September 13, 2001, Turkey at a glance, accessed September 28, 2001, at URL http://www.worldbank.org/cgi-bin/sendoff.cgi?page=%2Fdata%2Fcountrydata%2Faag%2Ftur_aag.pdf). The contribution of the primary mineral sector to the economy has been in the range of between 1.1% and 1.5% of the GDP. Total revenues of the mineral industry (primary mineral commodities plus processed mineral commodities, should include refined petroleum products and steel) were estimated to account for about 10% of the GDP.

Government Policies and Programs

The Ministry of Energy and Natural Resources was responsible for mining and petroleum operations. Mining was regulated by the Mining Law No. 3213 of 1985. Hydrocarbon activities were regulated under law No. 6326 of 1954, law No. 6556 of 1955, law No. 6987 of 1957, law No. 1702 of 1973, and law No. 2808 of 1983.

The initiation of a structural reform program by the Turkish Government in December 1999 resulted in a drop in the inflation rate in 2000 to about 39%; this was down from an average inflation rate of 73% per year endured during the 1990s (U.S. & Foreign Commercial Service, [undated], Turkey—Major trends and outlook, accessed October 5, 2001, at URL http://www.usatrade.gov/website/ccg.nsf/DC6D0C7300748AE2852568DA004BA257/852568E1005872D085256AB0004C9A67?OpenDocument).

Trade

Total Turkish exports were valued at $27.8 billion in 2000; this was up from $26.6 billion in 1999. Turkey was a significant exporter of borates and steel. In addition to exports of limited quantities of chromite, copper, and zinc ores and ferrochromium and refined metals, the country also exported a wide variety of industrial minerals and derived chemicals. Exports of crude mine and quarry materials accounted for 1.4% of the value of total Turkish exports in 2000, and those of processed mineral commodities accounted for about 16% of the value of total exports (State Institute of Statistics, 2001, Table 5—Exports by selected chapters, accessed October 9, 2001, at URL http://www.die.gov.tr/ENGLISH/SONIST/DISTICIST/27020005.gif; State Institute of Statistics, 2001, Table 11—Annual foreign trade by international standard industrial classification, accessed October 9, 2001, at URL http://www.die.gov.tr/ENGLISH/SONIST/DISTICIST/27090111.gif).

The value of Turkish iron and steel exports increased to $2.3 billion in 2000 compared with $2.2 billion in 1999. Aluminum exports increased to $295 million in 2000, which was up from $260 million in 1999; much of the increase was attributed to shipments of bars and flat products. Copper exports increased to $221 million in 2000 compared with $180 million in 1999. Dimension stone exports increased to $189 million in 2000 compared with $151 million in 1999. Borates exports decreased to $108 million in 2000 compared with $123 million in 1999, and ferrochromium exports dropped to $20 million in 2000 compared with $69 million in 1999. (Istanbul Mineral Exporters' Association, [undated], Turkey's statistical data by product group, accessed June 8, 2001, at URL http://www.immib.org.tr/Eng/maden/stat/urun.htm; Istanbul Ferrous and Non-ferrous Metals Exporters' Association, [undated] Ferrous & non-ferrous metal export by product group of the 2000 year, accessed October 9, 2001, at URL http://www.immib.org.tr/Eng/demir/stat/urun.htm).

Turkey's mineral imports were dominated by crude oil and refined petroleum products, which were valued at $9.5 billion in 2000 compared with $5.4 billion in 1999. The Turkish steel industry depended on imported scrap as feed for the country's many electric-arc minimills. Turkish iron and steel imports were valued at $2.7 billion in 2000; this was up from $2.1 billion in 1999 (State Institute of Statistics, 2001, Table 6—Imports by selected chapters, accessed October 9, 2001, at URL http://www.die.gov.tr/ENGLISH/SONIST/DISTICIST/27010006.gif).

Structure of the Mineral Industry

Maden Tetkik ve Arama Genel Müdürlüğü was the state agency responsible for geologic exploration, mapping, and research in Turkey. Most of the nation's nearly 3,000 mines were small by world standards.

Despite the divestment of a large portion of the state-owned minerals sector holdings to domestic and foreign investors, the Government remained a significant factor in most sectors of the Turkish minerals industry through shareholdings in a number of private companies and various state-owned industrial corporations, which included companies of Eti Holding A.Ş. Genel Müdürlüğü group that produced aluminum, boron, chromite, copper, and silver; Türkiye Taşkömürü Kurumu Genel Müdürlüğü, which mined hard coal; and Türkiye Komur İşletmeleri Kumumu, which produced much of the country's lignite and semibituminous coal. Most of Turkey's output of crude petroleum and natural gas was produced by the Government-owned Türkiye Petrolleri Anonim Ortaklığı (TPAO) and its subsidiaries. Domestic production and imported crude oil were the feedstock for the oil refineries of the state-owned Türkiye Petrol Rafinerileri A.Ş. (Tupras). In 2000, the Government's Privatization Administration offered to sell off all or part of such mineral concerns as Asil Çelik Sanayi ve Ticaret A.Ş., a steel producer; Ereğli Demir ve Çelik Fabrikalari T.A.Ş., steel; İskerderun Demir ve Çelik A.Ş., steel; İstanbul Gübre Sanayii A.Ş., fertilizer; Karadeniz Bakir İşletmeleri A.Ş. (KBİ), copper; Türkiye Gübre Sanayii A.Ş., fertilizer; Tupras; and a number of seaport operations. Most of the privatization tenders, however, were canceled.

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[1] Where necessary, values have been converted from Turkish lira to U.S. dollars at the rate of TL624,754=US$1.00 for 2000 and TL420,649=US$1.00 for 1999.

Commodity Review

Metals

Copper.— Çayeli Bakir İşletmeleri A.Ş. [the joint venture of Inmet Mining Corp. (49% equity interest), Eti Holding (46%), and the Government (5%)] increased the capacity of the mill at the Çayeli copper mine to 1 million metric tons per year. Operations were disrupted for nearly a month in January with mill problems and again at yearend when union employees walked out in December. Because of the interruptions, only 861,000 metric tons (t) of ore were milled in 2000 from which about 37,400 t of copper and about 26,000 t of zinc were recovered compared with 1999 when 897,000 t were milled from which about 40,100 t copper and 32,600 t zinc were recovered (Inmet Mining Corp., 2001, p. 7, 19, 46). During 1999, Çayeli had installed a paste backfill system that allowed some of the tailings generated by the plant to be mixed with cement and pumped into the mine for use as backfill. The system reduced operating costs with the elimination of the need to purchase gravel for backfill and decreased the volume of tailings disposed of offshore.

Gold.—Eurogold Madencilik Ticaret ve Ltd. A.Ş. became a 100% subsidiary of Normandy Madencilik A.Ş. after Normandy bought out the 33.3% interest held by Inmet Mining in early 1999. During 2000, Eurogold's resolution of many of the permitting problems that had delayed work at the Ovacık Mine near Bergama since 1997 resulted in the expectation that the mine could begin operations in early 2001.

Tüprag Metal Madencilik San. ve Tic. Ltd., Sti. (a subsidiary of Eldorado Gold Corp. of Canada), evaluated the development of the Kisladag gold prospect as an open pit mine and continued to drill the prospect to delineate the deposit. Difficulties with obtaining permits also delayed the company's Efemçukuru gold project.

Anatolia Minerals Development Ltd. terminated its joint venture with Rio Algom Ltd. in February. In April, Anatolia formed an exploration joint venture with Rio Tinto Mining and Exploration Ltd. The joint venture drilled and evaluated the Çukerdere copper-gold, the Kabataş copper-gold, and the Üçkapli gold properties. Additional drilling was planned for 2001.

Iron and Steel.—İzmir Demir Çelik Sanayi A.Ş. reportedly acquired 90% equity interest in the 150,000-metric-ton-per-year (t/yr) Akdemir Çelik Sanayi ve Ticaret A.Ş. rolling mill (Metal Bulletin, 2000b). Yaziçi Demir Çelik Sanayi A.Ş.'s joint venture acquired 94% equity interest in the 250,000-t/yr steel producer and mill Asil Çelik. The Yaziçi joint venture proposed to expand Asil Çelik's capacity to 400,000 t/yr (Metal Bulletin, 2000a, c).

Lead and Zinc.—Odyssey Resources Ltd. of Canada continued to drill its Lucky Star volcanogenic massive sulfide prospect, about 120 Kilometers (km) east-southeast of Samsum. In August 2000, Cominco Madencilik Sanayi A.Ş. (a subsidiary of Cominco Ltd. of Canada) acquired an option on Anatolia Mineral's Yahyali zinc property and planned to begin exploration in 2001.

The sale of the zinc smelter of Çinko Kurşun Metal Sanayii A.Ş. (Çinkur) was ordered by the Turkish courts. The Çinkur smelter had closed in November 1999 owing to power supply problems and remained closed in 2000 because the supply of Iranian zinc oxide concentrates formerly exported to Çinkur was diverted to new Iranian zinc smelters.

Industrial Minerals

Çukurova Group sold its magnesite producer Comag Continental Madencilik San. ve Tic. A.Ş. to Styromagnesit Steirische Magnesitindustrie GmbH of Austria. The former Comag operation was renamed Calmag Kalsine Manyezit Inalat ve Tic. A.Ş.

Mineral Fuels

In 1999 and 2000, Turkey imported 89% of its crude oil demand. TPAO was the country's leading crude oil producer, but crude production continued to decline. In 2000, TPAO's domestic production was down to 13.6 million barrels (Mbbl) (72% of total Turkish production) compared with 16.9 Mbbl (76% share) in 1998 (Turkish Petroleum Corp., Petroleum activities in Turkey, accessed October 5, 2001, at URL http://www.tpao.gov.tr/rpte/activities.htm). During 2000, 30 exploration and appraisal wells were drilled in Turkey. Successful exploration and development efforts resulted in the startup of the Yalankoz Field in southeastern Turkey by the joint venture of TPAO and N.V. Turske Perenco. The joint venture of TPAO and Amity Oil Ltd. discovered natural gas in the Thrace Basin with the Göçerler-1 well and proposed to build an 18.4-km pipeline to consumers in the Misinli industrial area.

Tupras' Izmit refinery continued to recover from the August 17, 1999, earthquake and fire. In 2000, the refinery was processing oil at about 75% of the rate it had averaged prior to the fire.

About 1 million barrels per day of Iraqi oil was exported through Turkey's Ceyhan oil terminal under the United Nations' (U.N.) oil-for-food exchange program (U.N. Security Council Resolution 986). In addition to the crude oil, Iraqi diesel fuel was brought across the border into Turkey at Habur.

Reserves

Turkey's mineral inventory was diverse and large (Erseçen, 1989). Resources of metallic commodities minable by large-scale methods were known for bauxite, chromite, copper and copper-zinc, gold, iron, and silver. Turkey was renowned for its industrial minerals deposits, most significant of which were barite, boron, clays, limestone and marble, magnesite, perlite, pumice, strontium, and trona. The country had large lignite reserves. Crude oil reserves were hosted in a number of small fields.

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TABLE 1
TURKEY: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 p/
METALS						
Aluminum:						
Bauxite 3/		544,513	369,482	458,028	207,743 r/	458,537
Alumina, gross weight:		159,298	164,333	156,825	159,122	155,448
Metal, smelter e/		60,000	62,019 4/	62,000 r/	62,000	60,000
Antimony:						
Ore, mine output:						
Gross weight		5384	585	500 e/	3400 r/ e/	6800 e/
Sb content		285	31	30 e/	180 r/ e/	360 e/
Concentrates:						
Gross weight		700	500	100 e/	500 r/ e/	1000 e/
Sb content		175	125	20 e/	100 r/ e/	200 e/
Cadmium		42	89	69	64 r/	--
Chromite, gross weight (34% to 43% chromic oxide) 5/		1,279,032	1,702,623	1,404,470	770,352	545,725
Copper:						
Mine output (exclusive of pyrite): 6/						
Gross weight		3,518,754	3,797,874	4,052,175	4,297,170 r/	4,473,711
Cu content of ore		33,792	36,460	40,000 e/	73,051 r/	76,053
Metal:						
Smelter output (primary and secondary)		38,600 e/	32,491	35,000 e/	19,159 r/	954
Refined e/		100,700	111,400	91,800	78,000	78,000
Gold, byproduct of base metals refining e/ 7/	kilograms	1,000	1,000	1,000	1,200	500
Iron and steel:						
Iron ore:						
Gross weight	thousand metric tons	6,404	5,986	5,885	4,300 e/	4,500 e/
Fe content e/	do.	3,500	3,239 4/	3,200	2,300	2,450
Metal:						
Pig iron and ferroalloys:						
Ferrochromium		101,450	108,320	110,175	99,100 r/	97,240
Ferrosilicon		4,460	4,730	4,810	420 r/	--
Pig iron		489,516	577,427	456,465	314,670	300,000 e/
Steel, crude including castings	thousand metric tons	13,382	13,644	13,351	14,309	14,325

See footnotes at end of table.

TABLE 1--Continued
TURKEY: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 p/
METALS--Continued						
Lead:						
Mine output, Pb and Pb-Zn ores:						
Gross weight		234,541	262,260	292,065	284,504 r/	345,391
Pb content		10,971	13,113	13,500 e/	14,225 r/	17,270
Concentrates:						
Gross weight		4,494	12,063	12,100 e/	11,500 r/ e/	13,000 e/
Pb content		3,140	7,912	7,900 e/	7,500 r/ e/	8,500 e/
Metal, refined e/		4,000	7,000	8,000	4,000	4,000
Manganese ore, gross weight 8/		37,000 e/	31,160	53,283	29,000 r/	23,300
Silver, mine output, Ag content e/ 9/	kilograms	70,000	90,200	110,000	100,000	110,000 e/
Zinc:						
Mine output, Zn and Pb-Zn ore:						
Gross weight		104,819	79,035	45,795	4,630 r/	--
Zn content		14,921	11,255	6,000 e/	545 r/	--
Concentrates:						
Gross weight		9,981	7,525	5,000 e/	500 r/ e/	-- e/
Zn content		5,529	4,169	3,000 e/	300 r/ e/	-- e/
Metal, smelter, primary		22,392	37,074	35,716	33,179 r/	--
INDUSTRIAL MINERALS						
Aluminum sulfate (alunite)		6,625	8,323	10,624	11,264 r/	12,266
Barite, run of mine		104,872	226,594	160,042	150,058 r/	120,893
Boron minerals:						
Run of mine		2,400,635	2,602,386	2,754,082	2,554,404 r/	2,398,220
Concentrates		1446697	1568571	1650000 e/	1500000 r/ e/	1450000 e/
Cement, hydraulic	thousand metric tons	35,214	36,035	38,200	34,258 r/	35,825
Clays:						
Bentonite		515,452	521,158	565,708	899,614 r/	636,273
Kaolin		449,561	472,646	403,733	449,954 r/	595,415
Other e/		6,405,377 4/	6,400,000	6,000,000	6,000,000	6,500,000
Emery		11,092	12,345	19,027	14,535 r/	16,830
Feldspar, run of mine		910,814	1,011,542	1,089,483	1,369,655 r/	1,147,716
Fluorspar		4,828	5,000 e/	5,000 e/	4,812 r/	4,113
Glass, crude	thousand metric tons	1,133	1,369	1,410 e/	1,203	1,300 e/
Graphite, run of mine e/		20,000	15,000	15,000	15,000	15,000
Gypsum, other than that for cement		754,277	413,802	351,557	242,960 r/	302,552
Lime 10/	thousand metric tons	1,023	1,170	1,066	975 r/	914
Magnesite, run of mine		2,339,138	1,409,768	2,703,343	1,724,744 r/	2,672,089
Meerschaum	kilograms	500	400	400 e/	400 e/	500 e/
Nitrogen, N content of ammonia e/		518,800 4/	558,000	560,000	82,400	53,400
Perlite, run of mine		157,580	103,416	124,312	147,818 r/	149,429
Pumice		774,000 11/	681,000 11/	579,000 11/	950,189 r/	787,081
Pyrites, cupreous, gross weight		538,140	559,500	699,408	896,519 r/	561,565
Silica sand, gross weight	thousand metric tons	1,514	843	1,138	1,211 r/	1,485
Sodium compounds:						
Salt, NaCl, all types	do.	2,068	2,344	2,170	2,146 r/	2,126
Soda ash (trona) e/	do.	400	500 4/	500	500	500
Sodium sulfate, concentrates		328,953	300,000 e/	300,000 e/	438,069 r/	456,590
Stone:						
Dolomite		981,683	689,989	829,775	921,105 r/	957,182
Limestone, other than for cement	thousand metric tons	40,456	49,108	52,355	28,045 r/	30,295
Marble	cubic meters	275,000 r/ e/	433,517 r/	633,432 r/	739,240 r/	647,160
Quartzite		2,807,279	1,878,339	2,301,270	2,514,383 r/	2,743,271
Strontium minerals, celestite: e/						
Run of mine		50,000	50,000	50,000	40,000	40,000
Concentrates		30,000	30,000	30,000	25,000	25,000
Sulfur: e/						
S content of pyrites		126,000 r/	63,000 r/	-- r/	91,000 r/	60,000
Byproduct:						
Petroleum		37,000 r/	46,000 r/	54,000 r/	47,000 r/	50,000
Other		39,000 r/	91,000 r/	91,000 r/	75,000 r/	90,000
Total		202,000 r/	200,000 r/	145,000 r/	213,000 r/	200,000
Talc e/		4,000	4,000	5,000	48,378 r/	54,278

See footnotes at end of table.

TABLE 1--Continued
TURKEY: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1996	1997	1998	1999	2000 p/
MINERAL FUELS AND RELATED MATERIALS						
Asphalt, natural		126,751	117,310	157,334	150,000 e/	150,000 e/
Carbon black		39,273	39,061	39,971	26,379 r/	35,144
Coal:						
Hard coal, run of mine	thousand metric tons	3,582	3,646	3,336	2,738 r/	3,330
Lignite, run of mine	do.	57,532	56,780	66,499	66,706 r/	61,315
Coke and semicoke	do.	2,297	2,335	2,144	2,811	2,090
Gas:						
Natural, marketed	thousand cubic meters	203,967	250,804	561,995	718,806 r/	611,822
Coal, manufactured e/	do.	37,000	35,000	15,000	-- r/	-- 4/
Petroleum:						
Crude	thousand 42-gallon barrels	25,015	24,696	23,072	21,157 r/	19,783
Refinery products:						
Liquefied petroleum gas	do.	9,580	8,418	8,774	8,071 r/	7,409
Gasoline	do.	30,950	33,067	31,673	38,096 r/	39,889
Naphtha	do.	13,227	13,644	15,917	16,106 r/	15,717
Jet fuel	do.	11,324	13,445	13,767	11,883 r/	11,009
Kerosene	do.	726	578	583	730 r/	638
Distillate fuel oil 12/	do.	55,838	55,248	59,860	69,551 r/	70,333
Lubricants	do.	2000 e/	4177	4714	4501 r/	4322
Residual fuel oil	do.	49,459	48,012	44,818	9,512 r/	8,769
Asphalt	do.	7,233	8,029	10,912	7,635	7,764
Unspecified 13/	do.	4,000 e/	33	26	1,644 r/	3,110
Total	do.	184,337	184,651	191,044	167,729 r/	168,960

e/ Estimated. p/ Preliminary. r/ Revised. -- Zero.

1/ Table includes data available through October 5, 2001. Large quantities of construction materials (clay, sand, and gravel) are quarried. Also mined are basalt diabase, granite, onyx, sandstone, serpentine, slate, and travertine for building stone, limestone and gypsum for cement manufacture, and zeolite; but information is inadequate to estimate output.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ Data are for public sector only. Data for private sector production are not available, but production is believed to be approximately 30,000 metric tons per year.

4/ Reported figure.

5/ Approximately 70% of gross production is salable product. Previously reported estimates of salable product in metric tons: 1996--900,000; 1997--1,300,000; and 1998--1,000,000.

6/ Copper mines produce a copper concentrate (of about 22% Cu) and a cupreous pyrite concentrate (about 0.7% Cu). Copper is not recovered from the cupreous pyrite concentrate.

7/ Data are estimated content of Turkish copper refinery tankhouse slimes.

8/ Does not include manganiferous iron ore from the Deveci Mine, production of which amounts to several hundred thousand tons per year and has a manganese content of 3% to 5%.

9/ Includes estimated content of base-metals refinery tankhouse slimes.

10/ Data are lime produced for steel production and do not include the widespread artisanal production of lime for whitewash and sanitation purposes.

11/ Turkish pumice production was officially reported in cubic meters and has a density reported to range from 0.5 to 1.0 metric ton per cubic meter. Values in this table have been converted by using 1 cubic meter=0.75 metric ton.

12/ Diesel fuel (gasoil) and special heating oil.

13/ Includes refinery fuel and losses.

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